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SEE PAGE 47

NEW INVENTIONS · MECHANICS · MONEY MAKING IDEAS
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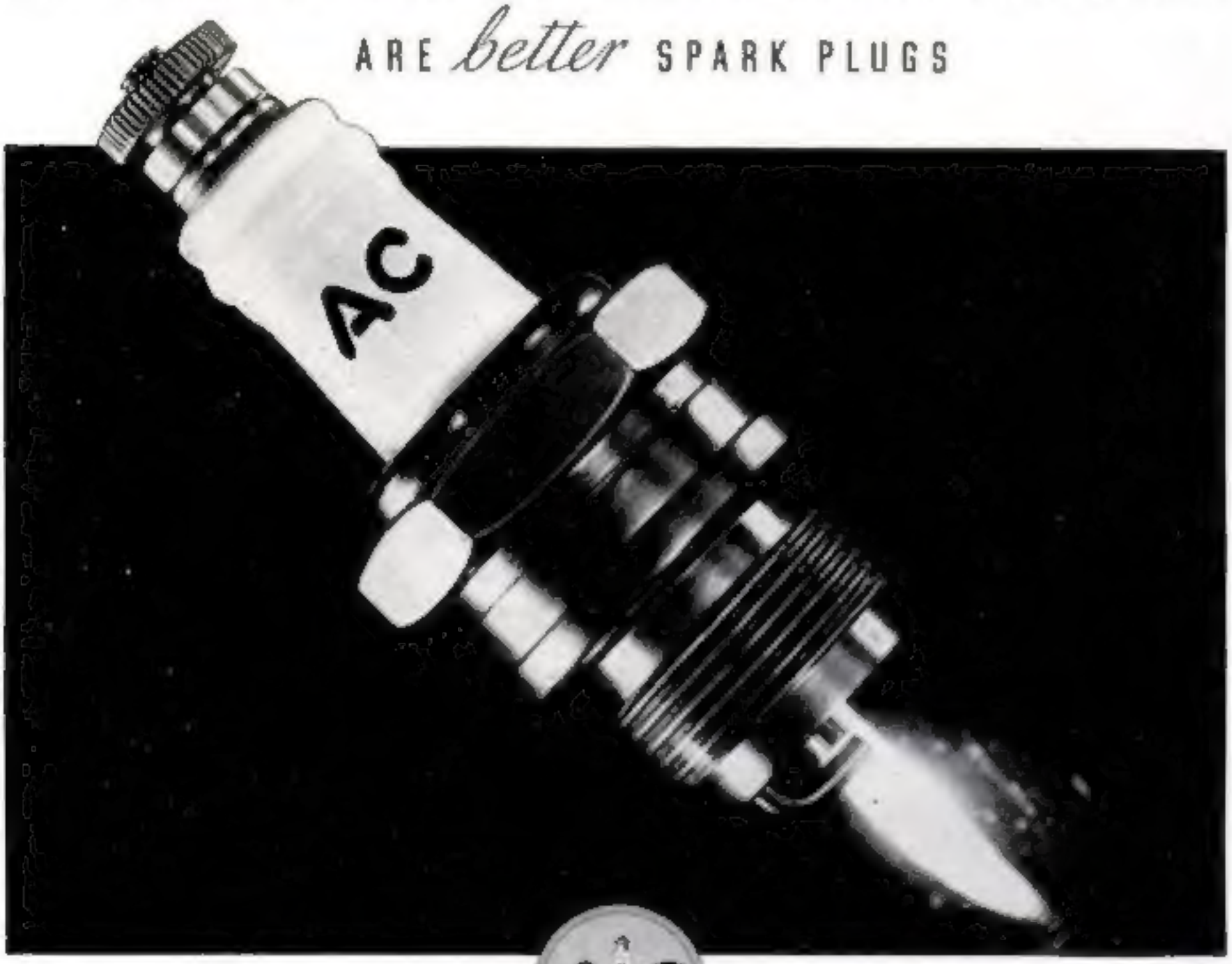
SEVEN OUT OF EVERY TEN MOTOR CARS BUILT TODAY ARE EQUIPPED WITH AC SPARK PLUGS...BECAUSE THEY ARE *better* SPARK PLUGS



THE QUALITY AC SPARK PLUG

You may have to "shop around" for *some* things you buy; but it's very easy to choose the right spark plug if you follow the judgment of those who know spark plugs best—*motor car manufacturers.*

Their tests prove ACs so much better, as well as so much more economical, that AC spark plugs are used in seven out of every ten new cars and trucks built today.

ACs owe their leadership to these five patented features: (1) one-piece heat-sealed construction; (2) exclusive AC insulator combining great heat-resisting qualities with mechanical strength; (3) welded side-electrode; (4) unglazed insulator tip; (5) Isovolt electrodes. Technical features, of course—but vitally important. Your dealer will gladly explain how much they contribute to better engine performance.

You may be surprised to learn that there is no price premium on these finer plugs. For AC—the quality spark plug—retails at *the lowest price* of any factory-approved plug—60c (75c in Canada).

It pays to install new spark plugs every 10,000 miles —because worn plugs waste one gallon of gasoline in every ten, and waste power and performance, too.

AC SPARK PLUG CO.

FLINT, MICHIGAN * ST. CATHARINES, ONTARIO

"I know All Three— FROM THE BOTTOM UP!"

A CERTIFIED INTERVIEW WITH ROBERT RICE, GAS STATION MANAGER, 59 ALGER AVE., DETROIT, MICH.

"YOU SOON LEARN which cars are 'oil hogs' on this job—and I found Plymouth is NOT among them."

"LOOK at Plymouth from underneath. You'll see it's solidly built."

"NATURALLY, WE WANTED a good-looking car on our honeymoon. I wanted a safe one, too . . . and one experience with Plymouth convinced me it's the safest low-priced car made!"

"...and now I'm driving my THIRD Plymouth"

IF YOU SAW a hundred cars a day—talked to all the owners—"got out and got under" as often as Bob Rice does—you'd know "all three" low-priced cars pretty well.

So the important thing in this story is this: Bob Rice's present Plymouth is his *third*.

Plymouth's solid foundation—a rigid-X double-drop frame—was one thing that sold him. Heat-resisting valve inserts that let you go 30,000 miles without valve grinding was another.

But the biggest thing, perhaps, was an accident.

Two cars crashed—and both hit Rice in his Plymouth. His car went completely over—but neither he nor Mrs. Rice were scratched. Not even a pane of glass was broken!

You can't sell him anything but a safety-steel body after that!

• • •

BOB RICE calls Plymouth a "young people's automobile" . . . because Floating Power engine mountings, safety-steel body and hydraulic brakes make it *modern*.

"Look at all three" low-priced cars—ride in them—compare the way they're built—and you can buy as soundly as Bob Rice did.

Standard Models: 2-door sedan $465; 4-door sedan $510; rumble coupe $485; business coupe $445. De Luxe Models: 2-door sedan $525; 4-door sedan $575; conv. coupe $595; rumble coupe $545; business coupe $495. Floating Power engine mountings, hydraulic brakes, safety-steel bodies standard. All prices F.O.B. factory, and subject to change.

NEW PLYMOUTH SIX

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FEATURES AND DEPARTMENTS

Cover Design by EDGAR F. WITTMACK

AUTOMOBILES

AVIATION

How a man of 40 can retire 15 years from today

IT makes no difference if your carefully laid plans for saving have been upset by the depression. It makes no difference if you are worth half as much today as you were in 1929.

Now, by following a simple, definite Retirement Income Plan, you can arrange to quit work forever fifteen years from today with a monthly income guaranteed to you for life.

Not only that, but if something should happen to you before that time, we would pay your wife a monthly income as long as she lived. Or if you should be disabled, and were unable to continue your payments, we would make them for you and pay you a disability income besides!

$250 a Month beginning at age 55

Suppose you decide that you want to be able to retire on $250 a month beginning at age 55. Here is what you get:

1. A check for $250 when you reach 55 and a check for $250 every month thereafter as long as you live.

2. A life income for your wife if you die before retirement age.

3. A monthly disability income for yourself if before age 55 serious illness or accident stops your earning power for good.

It sounds too good to be true. But it isn't. There are no "catches" in it, for the Plan is guaranteed by an 82-year-old company with $500,000,000 insurance in force. If you are in good physical trim, and are willing to lay aside a modest portion of your income every month, you can have freedom from money worries and you can have all the joys of recreation or travel when the time comes at which every man wants them most.

The Plan is not limited to men of 40. You may be older or younger. The income is not limited to $250 a month. It can be more or less. And you can retire at any of the following ages you wish: 55, 60, 65, or 70. How much does it cost? When we know your exact age, we shall be glad to tell you. In the long run, the Plan will probably cost nothing, because, in most cases, every cent and more comes back to you at retirement age.

Write your date of birth in the coupon below and mail it today. You will receive, without cost or obligation, a copy of the interesting illustrated booklet shown at the left. It tells all about the new Phoenix Mutual Retirement Income Plan. Send for your copy of the booklet now. The coupon is for your convenience.

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POPULAR SCIENCE MONTHLY for NOVEMBER, 1933

In This Issue—Hundreds of Fascinating Articles Tell the Latest News of Laboratory Discoveries, Scientific Triumphs, and Amazing New Inventions

Get A FLYING START TO SUCCESS IN AVIATION!

With the Greatest Guide Book Ever Published

THE AVIATION MANUAL

This book *will* save months of time and hundreds of dollars by giving you a thorough ground training in Aviation. You need it whether you're going to be a pilot, mechanic, radio operator, salesman or executive. The Aviation Manual, with its 700 pages and 250 diagrams and illustrations, covers the whole field so expertly that it will always be a reliable reference book—even long after you've finished your preliminary work!

LOOK AT THIS LIST OF 24 FULL CHAPTERS

all by leading authorities

All Covered in Fullest Detail

Opportunities in Aviation—The Business of Flying—License Requirements—Qualifications for Flying—Training To Be an Aviator—Your Background of Knowledge—Aviation Schools and Flying Clubs—How to Get the Most Out Of a Flying Course—Your First Outfit—Standard Airplanes, Seaplanes, and Amphibians—The Construction of Planes—Power Plants—The Manufacture of Engines—Instruments—Elementary Airplane Design—Materials and Their Properties—Wings and "Props"—Wind and Weather—How a Pilot Inspects His Plane—Learning to Fly—Advanced Flying—Laying an Air Course—Air Traffic—The Laws of Aviation. The Aviation Manual is edited by Lieut. Commander John W. Iserman, U. S. N. R. He has over 5,000 flying hours to his credit, and is now commanding officer of squadron VN3rd of the U. S. Naval Reserve. Many of his former student officers are now holding important positions in the Aviation industry as pilots and executives.

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Name_____

City_____ State_____

Address_____

A Sensational New Business

That—Almost Overnight—Can

Sweep You to Riches

This is among the first public announcements of what is undoubtedly the most amazing money-making opportunity ever offered to the readers of this—or any other—magazine. It tells how any ambitious, level-headed man can establish—practically overnight—a remarkable new kind of business that can pay a steady net cash profit of $40.00 a day—a business that offers unlimited opportunity—a business that is destined to make many men independently wealthy.

HERE, briefly, are the "high-spots" of this thrilling new business that will create "fortunes" for those with the vision and foresight to get in on the ground floor now:

1 An utterly new product with a natural, staple demand and big repeat business, yet one that has all of the appeal of a novelty.

2 Requires no house-to-house canvassing or selling. You simply manufacture. Stores will sell your entire output.

3 Produces $40.00 a day net profit, selling your entire output at wholesale.

4 A protected product and a protected process. Only our licensees can make or sell. Thus you are protected against cut-throat price competition.

5 Pays steadily; no lean seasons.

6 Big profits to be made in smallest town or largest city.

7 Absolutely no experience needed to be successful.

8 No expensive equipment needed. Your whole investment will be less than your first week's potential income.

This is truth; not fiction—fact; not theory. To the best of our knowledge, no other business in America offers one-tenth the opportunity for profit and independence.

Vision Turned to Reality

A few months ago, this amazing money-making product was nothing more than a dream—the vision of its inventor, Mr. R. H. Newitt of Chicago.

Today, the Newitt-Metzger process is a reality with every detail perfected—complete with tested plans of operation worked out—all necessary equipment ready to turn over to those who are prepared to develop this new "gold mine."

No Selling—No Canvassing

Do not confuse this new product with anything you have ever heard of before. It is not a potato chip, not candy, not a cheese chip, not a paste preparation, not a popcorn—but a natural product that comes from the sky, from the ground, and from the air. It is not like anything you ever saw or heard of, or imagined. The simple truth about it is stranger than your wildest dream. And you can be the first to supply this great demand, selling your entire output at wholesale to stores.

$100.00 a Week, Net, to Start

According to accurate figures, the very minimum of the first operation should produce a net cash profit of at least $100.00 a week. Since it is possible to make $40.00 a day, you can see that it would take only two and a half days of full operation to make a profit of $100.00. This, we figure to be a minimum. We would not be interested in licensing men who could not make at least that much every week. Then, as demand increases, other men can be put to work for you and you can double, triple, or quadruple your weekly profit as steady repeat business develops.

No Expensive Equipment

Ordinarily a proposition as big as this would require the purchase of expensive equipment. But our manufacturing process has been so simplified that we can furnish you with everything you need, start off making a profit the very first day—all for an investment of less than $150.00.

No Experience Needed

Absolutely no experience is required to quickly become successful in this thrilling and fascinating new business. We tell you how to start—how to establish yourself quickly—how to operate the business the very day you are ready to go. We furnish all necessary plans, systems and equipment. Any man with ordinary intelligence and a real desire to succeed is bound to make money.

Small Town or Big City

Another feature that makes this business unlike any other is that it can be operated anywhere. No matter where you live—in the smallest town or the largest city—you can establish yourself practically over night and start enjoying an independent income at once. From the foregoing facts, you can readily see that this is not a business for the timid operator who is satisfied to make a bare living, but for the wide-awake, aggressive go-getter who wants to see his energy and enthusiasm produce the greatest possible results in the shortest possible time.

Facts Sent Free

To all such men, we request permission to mail an unusual and complete presentation. After you have read the amazing facts and figures in this presentation, then you can decide whether or not an initial investment of less than $150.00 is too much to ask for a complete business that can pay back that investment in the first four days of operation, and then continue to pay as much as $252.00 a week net profit for single equipment operation, and up to as high as a thousand a week net profit to those men who have the ability to organize and direct other men.

Act Quickly

There is no time to lose. Today this proposition is new. Tomorrow it will be a little older—next week a little older still. So get the facts without a moment's delay. It's the newcomers in any enterprise of this sort—the "ground floor operators"—who always reap the richest rewards.

There is no coupon on this page. We do not want to hear from coupon clippers. If you don't agree that this is worth a letter—or a telegram—you are not the man for the business.

So write or wire today—without the slightest cost or obligation—and get the information that can make you independent for life.

KING K. CO. Dept. K-1811
54 West Illinois St.
CHICAGO ILLINOIS

What Does Your Hobby Mean to You?

"I'VE got more fun out of life following my hobby," writes H. R. Gordon of Rochester, N. Y., "than anything else I can think of.

"Ever since I've been old enough to smash electric trains I've been 'nuts' about model railroading. In the last few years the depression gave me more spare time than I could use. I naturally gravitated back to my old hobby. At first, slowly, then with more interest—and now with a devotion that even amazes me at times."

There's food for thought in this short letter. Undoubtedly Mr. Gordon thinks model railroading is the only worth-while hobby in the world. The man who does shopwork thinks his hobby the most fascinating. And you—if you have a hobby—will back it against anyone's.

But the big point is that the problem of advantageously using spare time is one of the most important social problems in the United States today.

"NRA ACTS TO TEACH WORKERS TO PLAY"—thus reads a headline on the front page of a New York newspaper. Garment workers who have toiled as long as seventy hours a week now return to a thirty-five-hour job. In the gasoline field hundreds of thousands will work forty-eight hours instead of sixty. Throughout the country salesmen and women in countless small stores have been working fifty-four hours a week and more. Now they will work forty hours. What will these and other millions do with their newly found spare time?

No answer will be found over-night, nor will any single answer fit all cases, all conditions. This country, with its background of hard work and long hours, will find itself facing a drastic readjustment to new conditions. An educational job of vast proportions will have to be performed. Already, in New York City, a committee of men has been appointed by NRA officials for the sole purpose of studying and reporting on the proper use of leisure time which is now facing millions in this country.

Looking at it another way, spare time means hobbies—the cultivation and enjoyment of those outside activities which are of the most interest to the individual in his idle hours.

For many years this magazine has devoted a large section of its contents to hobbies. By publishing interesting and varied projects in useful hobby fields which men can follow in their spare time, POPULAR SCIENCE MONTHLY has brought before its readers the pleasures and profits all hobbies offer. Steadily the importance of these particular pages has grown. Constantly an increasing number of readers have come to look forward to the hobby pages each successive month.

The slogan, "WE DO OUR PART" now takes on immediate significance for us in this connection. It means that the magazine will go into action with new hobbies and new projects in fields already established. Will you do your part? Will you coöperate *(Continued on page 8)*

in making these hobby pages even more important, even more helpful to yourself and to all our readers?

The letters that cross the editor's desk every day have given us a truly amazing picture of the diversified interests men follow in their spare time. Of course, radio, automobiles and workshops are among the old stand-bys, but actually thousands are finding the fun and profit, too, in such hobbies as book-binding, scenery building, soap carving, tree surgery, block printing, crime detection, and a hundred others—all equally fascinating —which these letters are bringing to light.

Oddly enough, these readers, while believing their own hobbies to be the only ones, are still intensely interested in what others are doing. They want to know how far up the scale their preferences stand. And we, too, should like to know. What, for instance, is the most favored hobby with readers of POPULAR SCIENCE MONTHLY.

We'd like to gather this information and use the tabulated results as the basis for an article in the near future. We feel that the question is of sufficient importance in the daily lives of us all to warrant an intelligent and well-rounded summary of the hobbies people pursue, their comparative importance and their potential value to those engaged in following them.

More than this, if you will help us in knowing exactly what especial hobby interests you, it will enable us to see to it that material on this subject appears regularly in the magazine. POPULAR SCIENCE MONTHLY is edited for its readers; their expressed likes and dislikes are the most trustworthy guide the editor has in preparing material for publication. The articles on such hobbies as ship model making, microscopy, astronomy, home chemistry, furniture building, metal working and so on are published only because readers have asked for them and have demonstrated their interest.

Although we have attempted to cover virtually the entire hobby field, it may be that certain hobbies that interest many readers have been overlooked. Here is your opportunity to make sure that your favorite hobby is accorded the prominence you wish.

If you are interested we suggest that you fill out the form below and mail it to us. Or, if you wish, write us a letter, telling us about your hobby or hobbies, and what they mean to you. If you have pictures, send them, too. Address Hobby Editor, POPULAR SCIENCE MONTHLY, 381 Fourth Ave., New York, N. Y.

List Hobby or Hobbies (in order of importance) which you enjoy in your spare time .....

.....

.....

COMMENTS .....

.....

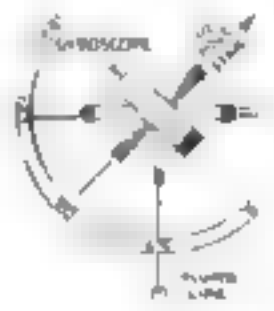
.....

Mail to HOBBY EDITOR,
POPULAR SCIENCE MONTHLY,
381 Fourth Ave. New York, N. Y.

Our Readers Say

This Idea Hit Him Like a Ton of Bricks

WHILE reading Gayland Johnson's article on the theory and use of the sextant, an idea hit me like a ton of bricks. Having at last recovered, I want to tell you all about it. When a gyroscope is set in motion, and its axis pointed toward some stationary point in space, it tends to remain pointed toward that spot regardless of the rotation of the earth or of the gyroscope's position on the earth. Now comes the big idea. Why not mount a gyroscope so it can turn freely in all directions, point its axis toward the polestar, and attach to it a dial calibrated through 180 degrees. Then with an artificial horizon, you would be able to read directly any time of day or night, your exact latitude. This idea seems so simple that there must be something wrong with it. Won't some reader please show me the hitch in it?—W. W. A., New York, N. Y.



How in the World Will The Water Reach the Fire?

IN A recent issue, you show the drawing of a flying fire engine invented by a Pittsburgh man. The idea seems screwy to me. The action drawing shows the airplane, which has scooped water from a lake, diving from a considerable height on a burning house with a long stream of water shooting ahead of it. In a dive, a streamlined plane would travel 120 miles an hour or faster, a whole lot faster than the water, pulled only by gravity as no pressure system is shown in the tank, could travel. If the water ever got out of the nozzles, it would streak back toward the tail, if it wasn't blown to spray. If my house gets on fire, I'll still be willing to depend on Hook and Ladder Number One.—R.A.H., Los Angeles, Calif.

Building a Model Circus Proves an Endless Job

Two more model circus fans would like to voice their desire to see an article on building a model railroad circus. We have been five years building a model but have never been able to find any articles on how others have built them. Would also like to see other readers explain some of the obstacles they encountered and how they overcame them. An article on building a model circus would be appropriate now, when there are only three large railroad circuses on the road. Incidentally a model circus is one model that is never finished. No matter how large the model or how complete, there is always some new wagon to build, or properties to add.—J.C.R. & H.P.G., Gloversville, N. Y.

Stamp Collectors Eager To Get All the Dope

WE WERE glad to see two articles about stamp collecting in a recent issue. The article "Rare Stamp Racketeers Thwarted by Black Light" was especially interesting and the hint by G. A. Bender was very good. We would like to see a few more articles along these lines. You could have some good stories on the printing of stamps both in U. S. and abroad. Also there are the stamp venders which require special coil stamps. Explain them.—E.A.G., Winnipeg, Can.

You Gotta Stop Kickin' This Airplane Around

I SEE so in a recent issue that the new steam-driven plane is getting knocked around by some of your readers. I have decided to put a stop to such conduct by submitting further information. P. P. Madison, Minn., questions the statement that the new steam plane gains in efficiency the higher it goes. He apparently does not understand that this plane is more efficient at high altitudes because of the lower air pressure. When the products of combustion leave an engine through the exhaust pipe, they cause a draft at the rear. Now since the exhaust in the new plane's steam engine leaves directly from the boiler, the draft is through the boiler and thus the engine always has a fresh supply of oxygen. Hence this serves the same purpose as the supercharger on the gas engine. I hope I have put this reader's mind at rest.—W.H., New York, N. Y.

Why a Rainbow? Isn't A Nice Moon Enough?

HAS anyone ever seen a rainbow during a shower on a moonlit night? We see them during the day, why not at night? Rainbows are nothing more than prismatic colors formed by light passing through the raindrops. With a bright moon and a local shower it seems to me that the same effect should be produced.—L.M.G., Lewistown, Pa.

You Do the Work, Not Your Permanent Magnet

IN A recent issue of POPULAR SCIENCE MONTHLY G.C. wanted to know where the energy came from that enables a permanent magnet, made by contact with an electromagnet to keep hanging pieces of iron indefinitely. I think he has forgotten something. When you speak of a piece of iron being lifted by a magnet, you usually mean that the magnet is holding the steel or iron while you lift the magnet. The actual lifting that the magnet will do is not very great, that is, the distance that the steel will jump to the magnet. Also he says that you can compute the energy going into the permanent magnet by watching the Watts input into the electromagnet. So much of the energy put into an electromagnet goes off as heat that it is practically impossible to tell what part actually went into the permanent magnet. I think that if you could make accurate measurements you would find no discrepancies.—F.B.K., Scarsdale, N. Y.

Hunting Down Her Man Is Not New to a Woman

I HAVE read every one of your articles on scientific crime detection. They have made me want to be a detective. I am eighteen years old and a girl. Everyone laughs at the idea of a girl being a detective. But with bobbed-haired bandits and gun molls, why shouldn't there be women detectives too? I read in the paper that Scotland Yard, the famous English detective bureau, has put on three women detectives. That's just a starter. What I am writing about is this. Why don't you give us an article upon what women have done in hunting down criminals? That would be something new and interesting and I am sure there are a lot of cases where women have used science to help trap wanted people. But all the articles I have seen in your magazine on crime detection just tell what the men have done.—Miss J. B., Philadelphia, Pa.

Now It's a Homemade Seismograph that's Wanted

A NUMBER of your faithful readers and I are very interested in astronomical and geographical theories. All we want now is for one of your authors to tell how to make a simple homemade seismograph. We know the principle but we cannot get the fine points worked out.—J.T., Wilson, N. C.

One Look Was Enough and Now He's a Booster

A FEW months ago I picked up a copy of POPULAR SCIENCE MONTHLY in a dentist's office and noticed the article on microscopes. Since then I have purchased the magazine regularly every month and have enjoyed each issue. Your article, "Flowers Found with a Microscope," was most interesting to me as I have derived more pleasure from the study of diatoms than from any other subject in the field of microscopy. In spite of what J.M.D. of Glasgow may think, I really believe that POPULAR SCIENCE MONTHLY has done wel

by printing thoughtful articles and would do even better by printing more of them Your magazine appeals especially to thoughtful and mature men and women. As long as you continue to print such worth-while articles as have appeared recently, I shall continue to buy POPULAR SCIENCE MONTHLY —P D P., Easton, Pa.

If It's Popular Now, He'd Make It a Wow!

LET me make a few suggestions that will serve to make your popular magazine even more popular than it now is Cut out the knot work and luggage-making articles Have a department on photographic contests and how to repair and sharpen old tools and use them in the shop and laboratory Establish a swap column in which readers can send in advertisements, for which you would charge two or three cents a word This will add to your receipts. Have another column, like "Our Readers Say," in which technical questions will be answered. If it required much research work, a charge can be made Have a vote every year as to what readers want in the magazine This will put a stop to all the howls in Our Readers Say column What do other readers think of this plan? R. B., Brooklyn, N Y

Please Bury It Gently Near the Age of Ann

THE checker problem of B A., of N Y. which appeared in a recent issue consisted of checkers arranged on the two outside rows of playing squares of an ordinary checker board. The problem was to jump a checker any direction each move until only one of the twenty-four original checkers remained The solution furnished by N F H Jr Crawford Ind is impossible as per his first six key moves, given as follows Move from 1 to 10, 4 to 11, 5 to 14, 20 to 19 12 to 23 and 20 to 22 If the pieces are jumped as stated, on a properly numbered checker board and the six jumped pieces all removed it will leave the remaining eighteen checkers arranged in long rows so it is impossible to perform the seventh jump. Is there an answer?—R C M., Lincoln, Nebr

Undoubtedly the Answer Is Years and Years and Years

IN a recent issue, R G F of Bedford Iowa seems to think that religious leaders have been, and still are, in the dark ages and that the evolutionist is the only one who has progressed. I have a very simple problem for some one to answer Science says and I suppose it's right, that every man, woman, boy and girl who dwells on this our globe, can be corded in a 1,320-foot cube Now suppose R G F and I were to get them all corded into this cube and just before he and I crawled in and shut the door, thus exterminating the human race, we should turn all the monkeys in the New York Zoo loose. How long would it take those brethren of mine to evolve into master minds like my good friend Darwin? I like your magazine fine In fact so well that each month when it comes my wife says good-by to me till I have read it from cover to cover.—D L P., Fulton, Ind.

Ten Trees in Five Rows And Four in a Row

HERE is an answer to the problem by J.D C., submitted in the September issue Draw a five-pointed star and arrange your ten trees on the five lines. That gives five rows with four in each row I hope that plans for a model state will soon appear, because your excellent articles have stimulated my desire to undertake such a project —J G T., New York, N. Y

Your Modest Request Will Be Duly Considered

IN your articles on the microscope and chemistry I should like to see some work on water analysis You could treat the bacteriological part of it in the microscope section and the chemical analysis in the chemical articles. It should prove especially interesting to those who have drinking water cisterns and wells —H K., Detroit, Mich

Evolutionist Speaks Up in Defense of the Theory

IN reading a letter written by F R S Torrington, Conn. in a recent issue, I feel it necessary to unburden my soul of a great sense of indignation. In the first place F R S takes issue with the statement that man is descended from monkeys. He is quite correct Evolutionists, provided they have an intelligent conception of the idea, agree with him thus far If F R S will take the trouble to read through any reliable book on evolution, he will find that there is nothing said concerning the descent of man from monkey The gist of the idea is that man and monkey are both descended from a common ancestor; probably some type of ground ape The idea is well illustrated by most competent writers on the subject by comparing evolution to a tree, the trunk of which is taken to represent man, while one of the main branches represents the apes. As far as the theory is concerned we must remember that man when confronted by a fact, does not rest until he has some explanation, be it true or false Before the days of true science, man tended to ascribe all the unexplainable to his God. Certainly to primitive people the origin of man and the earth was explainable in no other way Evolution does not walk hand in hand with atheism. On the contrary, it brings a realization of a precise, scientific, mathematical God, who is easy to believe in and who carries with Him a deep religion.—E.deH.A., Sayre, Okla.

Another Reader Takes a Wallop at Grumble Column

I CERTAINLY agree with I Mc D., of Glasgow, Scotland, that Our Readers Say should not be turned into a Grumble Column. How any of POPULAR SCIENCE readers can hope to detect flaws in the theories of Einstein, Jeans, and Eddington when only a very few men can understand these theories, is more than I can see. Surely Dr Dunraut and Dr Cooke know what they are talking about.—D.S P., Morristown, N. J

Probably Wear and Tear Of a Revolving Planet

DURING a recent conversation with a railroad man, he made the statement that the rails on stretches of road running east and west wear out faster than those running north and south. It sounds like a wild tale to me. Do you suppose the rotation of the earth has anything to do with it? Maybe some of your railroad-minded readers can explain it.—H R.S., Miami, Fla.

Little Microbes in the Air Give This Reader Quite a Scare

PLEASE do something to calm the fears of a nervous non-combatant who sees by the papers that disease germs may be used as deadly weapons in the next war I have just accustomed myself to the thought of bombs bursting in air and poison gas creeping, creeping like Dickens' dainty ivy, but this disease-germ idea isn't so easy to laugh off That is, if the furious enemy can tame his germs and teach them to bite only the stolen foe. How this is to be done I don't know and I suspect even the keenest warlord will find the job difficult Influenza pneumonia, and meningitis germs, once released into the air probably wouldn't be fussy about whom they attacked and might, I should think, easily become a destructive boomerang Still the idea of educated and disciplined disease germs stealing up on me in the night is far from pleasant and if any of your readers can quiet my alarm, I'll be grateful because I'm not one to get gay with a traveling microbe.—E J., Seattle, Wash.

Vanishing Light Is Gone But It's Not Forgotten

J K G., Tallahassee, Fla., seemed a bit worried about where light goes when it disappears. He said that he would be glad to receive a more explicit explanation of the phenomenon than had occurred to him. Perhaps this will help him. Light from an original source is a wave motion emitted from the interior of the atoms of that source. The ordinary cause of the emission of the waves is heat. The heat so affects the electrons or protons within the atoms that they produce the wave motion, light. When the heat is removed, the atoms' interiors cease propagating light waves When the waves fall upon a material body, the waves perhaps are passed undisturbed through the body, are reflected undisturbed or irregularly, or are partly or completely absorbed. The absorption of certain parts of light when it is reflected or transmitted causes color Sometimes nearly all of the light is absorbed by the body, causing J.K.G.'s "disappearance". Light waves, like all waves, are a form of energy When the waves are absorbed within the atom, the energy of those light waves is transformed into some other kind of energy, commonly, into heat.—J C H., Bremerton, Wash.

Sleep-Disturbing Problem Seeks Earth's Curvature

I ENJOY the pages of Our Readers Say very much but most of the problems are much too easy I should like to have some one find the curvature of the earth in inches per mile according to the drawing reproduced herewith We have given the diameter of the earth and wish to find the distance from the tangent AB to the earth's surface at points X Y and Z X being 1,000 miles from A, Y being 2,000 miles from A, and Z being one mile from A.—E.E.S., Lamar, Nebr.

WEAVING THE WORLD OF SPEECH

DAILY, as upon a magic loom, the world is bound together by telephone. There, in a tapestry of words, is woven the story of many lives and the pattern of countless activities.

In and out of the switchboard move the cords that intertwine the voices of communities and continents. Swiftly, skilfully, the operator picks up the thread of speech and guides it across the miles. Constantly at her finger-tips are your contacts with people near and far.

She moves a hand and your voice is carried over high mountains and desert sands, to moving ships, or to lands across the seas. London, Paris, Berlin—Madrid, Rome, Bucharest—Capetown, Manila, Sydney—Lima, Rio Janeiro and Buenos Aires—these and many other cities overseas are brought close to you by telephone.

Every day go messages vital to the interests of nations, the course of international business, and the affairs of individuals. Fifty operators, speaking a dozen languages in all, work in relays at the overseas switchboard in New York.

Great progress has been made in the past few years in extending the scope of this service, in speeding connections and in giving clear transmission. Today, more than 90% of the world's telephones are within reach of your Bell telephone.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY

POPULAR SCIENCE MONTHLY

November 1933 Vol. 123, No. 5

RAYMOND J. BROWN, Editor

Using visible light, this microscope is focused on specimen of an X-ray after which it is photographed with black light

Camera *and* BLACK LIGHT *find* New Mystery Metals

Built to scale, this model of metal structure is 6,000,000 times size of original. Balls represent atoms

By STERLING GLEASON

HAVE you seen an amphibian plane gleaming in stainless steel, flash across the skies?

Have you played an aluminum violin? Do you wear an aluminum wristwatch the weight of which is negligible?

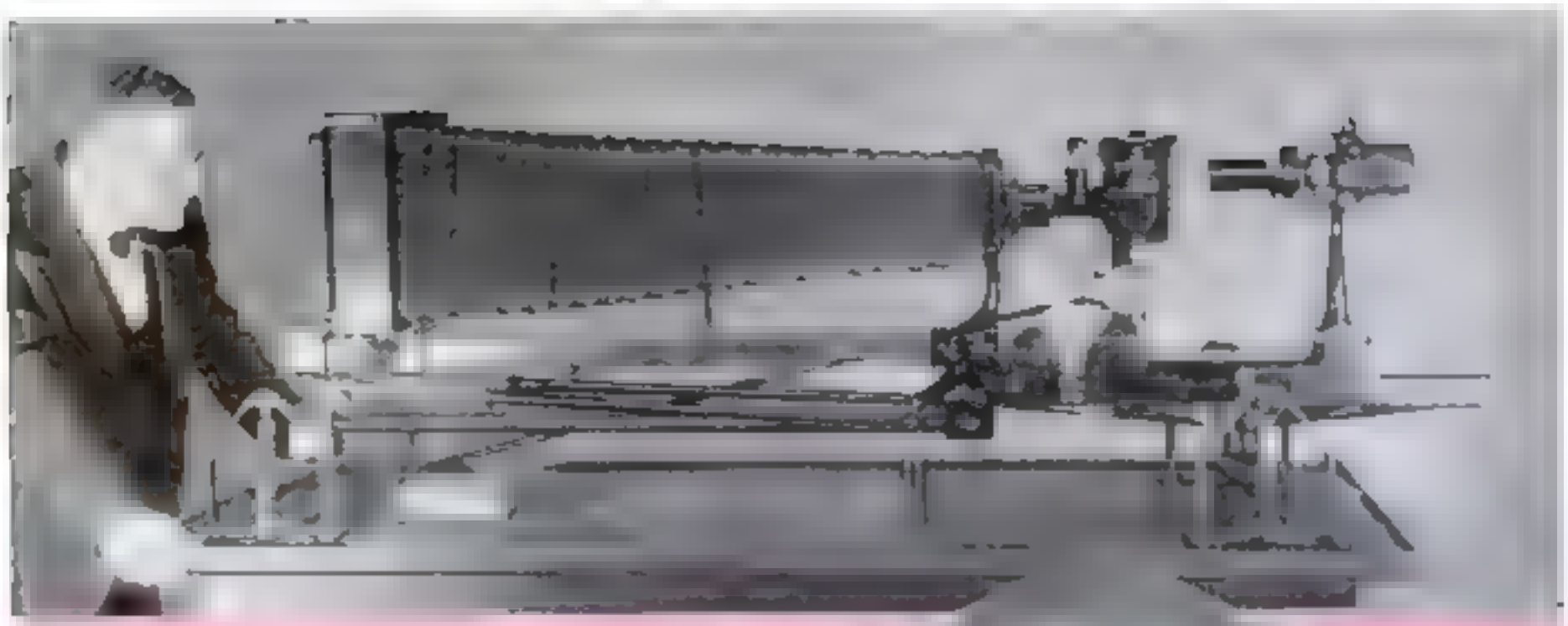
Do you know that your automobile's high-compression motor stands up under red-hot engine temperatures and piston speeds of 400 miles per hour, simply because its cylinder block contains alloys such as nickel, chromium, or manganese? Do you know that its clutch-pressure plate, made from a new heat-treated alloy, is twice as strong as the iron plate of last year's model?

New alloys of old metals are today working miracles in industry and in daily life. Perhaps you have ridden in one of the new aluminum street cars which run along almost noiselessly on forty per cent less power. Or maybe you have watched a steam shovel at work and noticed that its boom and bucket looked like aluminum; or that workmen were trundling extra-large white-metal wheelbarrows. If so, you have seen a few examples of the latest magic of the metallurgist.

Working in the laboratory with black-light microscopes, with radium torches, spectrographs, and X-rays, scientists are learning to rearrange the building blocks of matter into other patterns, thus making new metals of old. Brand-new properties have been found in super-refined zinc, aluminum, and manganese. Metals such as gold, platinum, copper, and aluminum can now be hardened to the strength of steel.

Then there are mystery metals, long sought by science to fill blank gaps in the table of elements, and now for the first time isolated and put to practical use. Stranger still are man-made metals you can look through, synthetic metals built atom by atom into films so thin they are invisible, and new micro-alloys, used as units in building new combinations of metals with properties as yet unknown.

To learn at first hand how scientists today are probing the deepest secrets of metals, I visited Dr. Alexander Goetz, famous "wizard of the crystal." In his underground laboratories at California Institute of Technology, almost unbelievable feats of magic are being performed as part of the most thorough study of metals ever attempted.



A whirring motion-picture ca[illegible] vast fumes a strange scientific dr[illegible] which threw new light on [illegible] ure. The camera's eye aided [illegible] a microscope magnifying [illegible] looked down into an electrolyte [illegible] where metal was being [illegible] piece by piece as an electr[illegible] stripped off layer at [illegible] Fascinated, Dr Goetz saw that instead of sweeping the metal away a layer at a time, the current picked off individual crystals, leaving pyramid-shaped peaks which one by one crumbled and vanished, exposing new pyramids beneath.

In the next room, an associate was using an X-ray spectrograph. Beams of X-rays, deflected by the crystals of a metal, were printing dots in geometrical patterns upon sensitive photographic plates. These, too, showed that metal is made up of millions of infinitesimal crystals, each as symmetrical as a snowflake.

Another scientist was laboring to produce a chemically perfect metal. He was drawing a rod of copper through a special electric furnace, from which it emerged with atoms lined up in parallel rows as long as the metal itself. This strange single-crystal metal could be bent, but once bent, could not be straightened. Its atoms slipped out of alignment, would not return to their position in ranks.

Dr Goetz showed me a perfect single crystal which he had built up from more than a trillion graphite crystals. In a gelatin-filled glass tube two inches long and a quarter-inch thick, he had organized them electrically into perfect rows, 250,000 to the inch, then allowed [illegible] to [illegible] countering any solid substance.

Searching out the properties of alloys is done in Dr Goetz' laboratories with unparalleled thoroughness. Starting with a pure metal, he adds only a very small per cent of another metal and then tests the properties of the combination. Amazingly powerful are the effects of these tiny impurities. In some way, the alloying material displaces atoms from their regular pattern, giving radically different properties. For instance, by adding extra atoms in the proportion of six in ten thousand, Dr. Goetz can make lead as [illegible] as steel.

This tableware looks like silver but actually it is of stainless steel that remains bright

To measure with incredible precision, these infinitesimal displacements, the X-ray spectrograph again comes into play. So accurate is this instrument that it gages distances down to one thousandth of an atom's diameter! From these X-ray blueprints, Dr Goetz, with wire and bits of modeling clay, builds models of the metal's structure. Built exactly ten million times as large as the original, these models show concretely what is occurring among the atoms of the new micro-alloy.

In a cryogenic, or super-cold, laboratory, Dr Goetz now chills metal crystals with liquid helium to make X-ray snapshots of their structure. The intense cold, approximately the temperature of interstellar space, acts as an anaesthetic on the vibrating atoms of the metal, halting their motion so they can be X-rayed more clearly.

At these temperatures, only three to four degrees above absolute zero, a strange transformation takes place. Metals become super-conductors and carry electricity virtually without loss. A current started in a loop of the supercooled wire will keep on flowing of itself for days or even months. Why? That is what Dr Goetz is trying to find out. Such low-resistance metals would have amazing uses.

Already Dr Goetz has made a step toward producing better electrical conductors at ordinary temperatures. By projecting a beam of metallic vapor upon another substance, he can build up films only one-atom thick. The one-atom layer is invisible, for the atoms must be piled up at least one hundred layers deep before they can be seen at all. By this method, atoms are spaced in any desired pattern. Thus Dr. Goetz has produced synthetic metallic films that conduct electricity three times better than silver, previously considered the best conductor.

New secrets of metals are being sought with the aid of the black-light microscope. Professor D. S. Clark, another research

X-ray photographs of crystals. They were used as a basis for building scale models of atomic structure. Above tungsten carbide magnified 1,000 times. Right cast iron, magnified 100 times

• BUILDING BLOCKS OF MATTER, NOW REARRANGED

scientist at California Institute of Technology, cuts a cross section of metal, buffs it to a high polish, then etches it with acid to throw it into highlight and shadow. Tiny, invisible vibrations of black light reveal to the photographic plate far finer details than visible rays can record.

Metals become as transparent as glass to a new radium torch now used at the U. S. Naval Research laboratory. Containing merely a tiny bit of radium in a brass container less than one-eighth of an inch long, it has the power to penetrate steel ten inches thick. Instead of the costly element itself, a tiny vial of its emanation, a gas given off as the radium decomposes, may be used. This simple device displaces cumbersome X-ray machines requiring more than a million volts to operate.

Also at California Institute of Technology, metallurgists showed me a freshly-rolled sheet of a brand-new alloy. Ninety-five per cent beryllium and five per cent aluminum, and more costly than gold.

"What is it good for?" I asked.

"Nothing," was the reply. "So far, we don't believe it has any practical use. It is too expensive and too hard to handle."

Back of the experimental alloy, however, lay another story. Only a few years ago, the element beryllium cost $5,000 a pound, and there were no buyers. By long, tedious work, chemists succeeded in extracting a small quantity of it from its ore, a common mineral well known as beryl. It seemed useless; but patient experts found that, when added in the right proportion, it made copper not only corrosion-proof, but capable of being hardened to undreamed of strength.

Research showed how to extract beryllium more cheaply, by low-temperature electrolysis. Today it is used in making corrosion-proof propeller blades, sparkling chisels, long-lived electrical switches, and for scores of other purposes. Late research has shown it to have radioactive properties.

A few years ago, prospectors in remote corners of the earth discovered small deposits of a very hard, granular metallic substance of remarkable resistance to acids. "No practical value," they declared. But an inventor found a use for the hard metal. His discovery made possible the modern fountain pen, whose tip lasts indefinitely. Man-made platinum-and-gold alloys are now produced with tensile strength of 190,000 pounds per square inch—the equal of the hardest steels thus far produced.

New power to rearrange crystal groupings has been given the metallurgist by the principle of heat treatment. Microscopic studies showed that proper heating causes one metal to dissolve another, as water dissolves salt. In cooling tiny crystals are formed. By proper control of temperatures, metals can be treated so that crystals will grow in fine, regular clusters that do not slip readily on one another, and hence give the metal great strength. "Precipitation hardening," a method of controlling the way crystals are precipitated, causes metal to "age" and grow stronger as time goes on. The process, beginning a few hours after the metal starts to cool, may go on for years.

Magic light-metal alloys are giving swift wings to big transport planes that otherwise would never get off the ground. Chromium-molybdenum steel sections, heat-treated in the electric furnace, grow in tensile strength from 90,000 to 180,000 pounds per square inch. Nickel steel bolts and trunions are even stronger. The skin and frame are made of duralumin, whose strength is more than doubled by aging. Thus a modern transport's wing could carry a load of thirty-six tons.

All alloy steel is cadmium-plated to pre- [illegible] as used for ex- [illegible] are aluminum [illegible]. Strangely, [illegible] wood and fabric [illegible] costs, since most [illegible] work that can [illegible]

[illegible] speed along the rails on [illegible] of higher strength [illegible] and bones are [illegible] Aluminum [illegible] per [illegible], [illegible] go [illegible] stronger [illegible]

[illegible] later in modern metal- [illegible] metallurgists [illegible] knife for [illegible] knives rusted and were [illegible]

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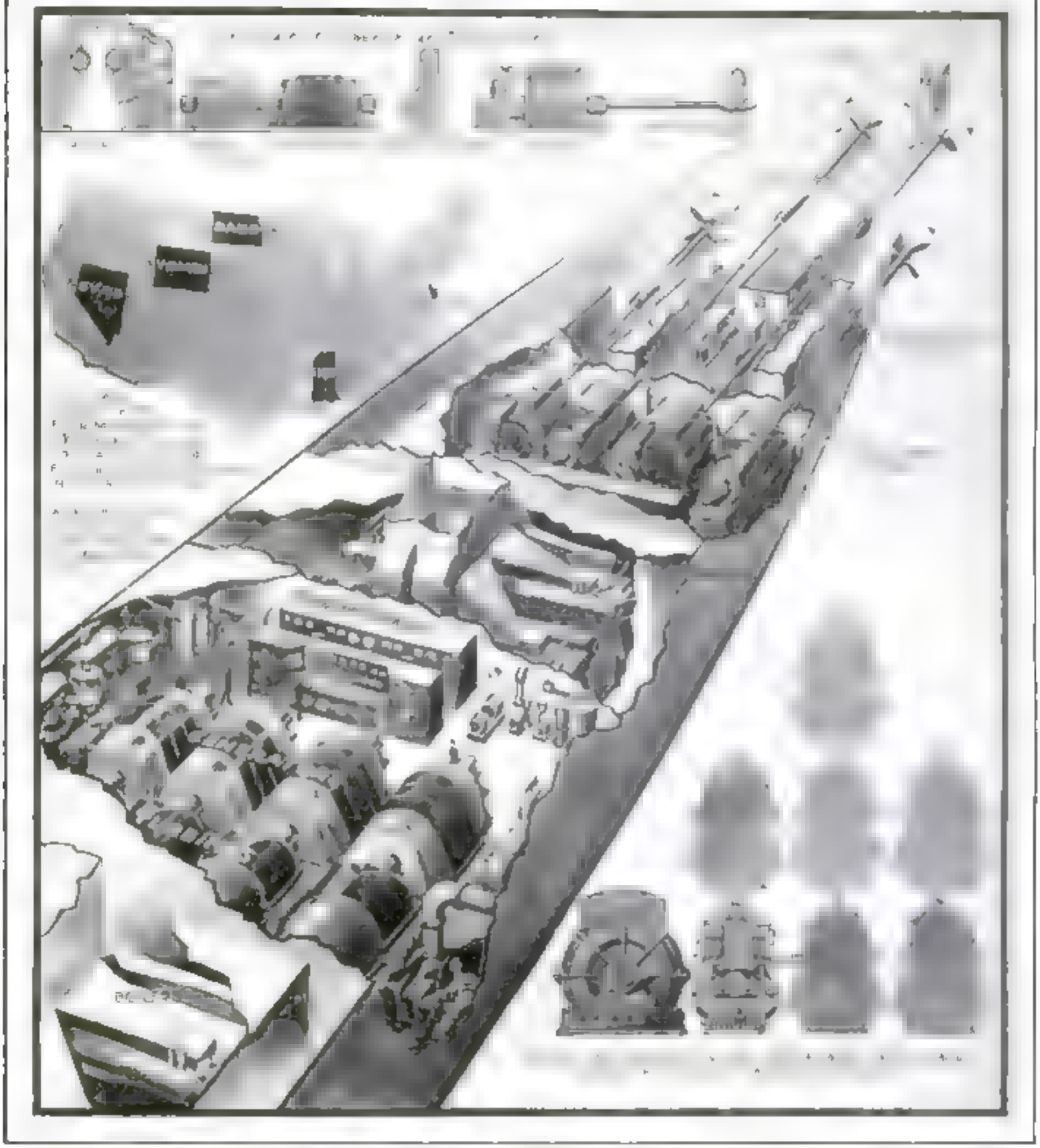
METALS BIGGER LOADS

[illegible]

IN STRANGE WAYS, WORK MIRACLES IN INDUSTRIES •



These drawings make clear how the power is generated and applied in an electric ship, such as the huge *Normandie* which is soon to make her maiden voyage across the ocean

Drawing by
H. G. SCHIESTAD

LATEST TRIUMPHS IN Electric Ships

The *Normandie* the world's biggest ship and the first transatlantic vessel to be fully electrified. She will be put in service next spring

Revolutionary Method of Propulsion Used in Gigantic *Normandie* May Herald Sweeping Change in Transatlantic Travel

By

Kenneth M. *Swezey*

WHEN the 75,000-ton French liner *Normandie* starts next spring on her first voyage westward, electrical power equivalent to the combined steam powers of the *Leviathan*, the *Majestic*, and the *Ile de France*, will whirl her giant propellers. Electrical machinery will haul her ropes, raise her anchors, guide her helm. A thousand electric servants will watch over every item of comfort and safety of her 3,500 passengers and crew.

Not only will the *Normandie* be the most completely electrified ship in the world, but she will be the first electrically-driven ship to pit her might against the directly steam-driven ship in the race for transatlantic supremacy.

From the earliest days of the steamship, until about 1907, this race was waged with the help of the constantly developed reciprocating engine. Edged on by the demand for larger and faster vessels, the simple steam engine of a few hundred horsepower grew into a double or triple-expansion engine of thousands of horsepower, until the maximum was reached in the 40,000-horsepower engines that drove the *Kaiser Wilhelm II*.

Then came the famous *Mauretania* with steam turbines, aggregating nearly 70,000 horsepower, coupled directly to her propeller shafts. Dashing across the ocean better than twenty-seven knots, her example revolutionized shipbuilding, and turbines became thenceforth the rule for the big ships.

The 110,000-horsepower turbines of the record-breaking *Bremen* and *Europa*, and the 120,000-horsepower turbines of the *Rex*, all of which are connected to the propellers through massive reduction gears, represent the most advanced and most powerful propelling machinery entered in the race as it stands today.

With no motive but to provide greater comfort, maneuverability, and speed, the 80,000,000 *Normandie* is the first liner of the North Atlantic to challenge this long tradition. Instead of spinning her propellers directly, or through gearing, her four mammoth turbines will drive great electric generators.

The electricity from these, in turn, will drive four huge motors coupled to her propeller shafts. With from 160,000 to 200,000 electrical horsepower at the instant command of her engineers, this largest ship ever built is expected to make the crossing between Havre and New York faster than any other merchant ship that ever sailed the seas.

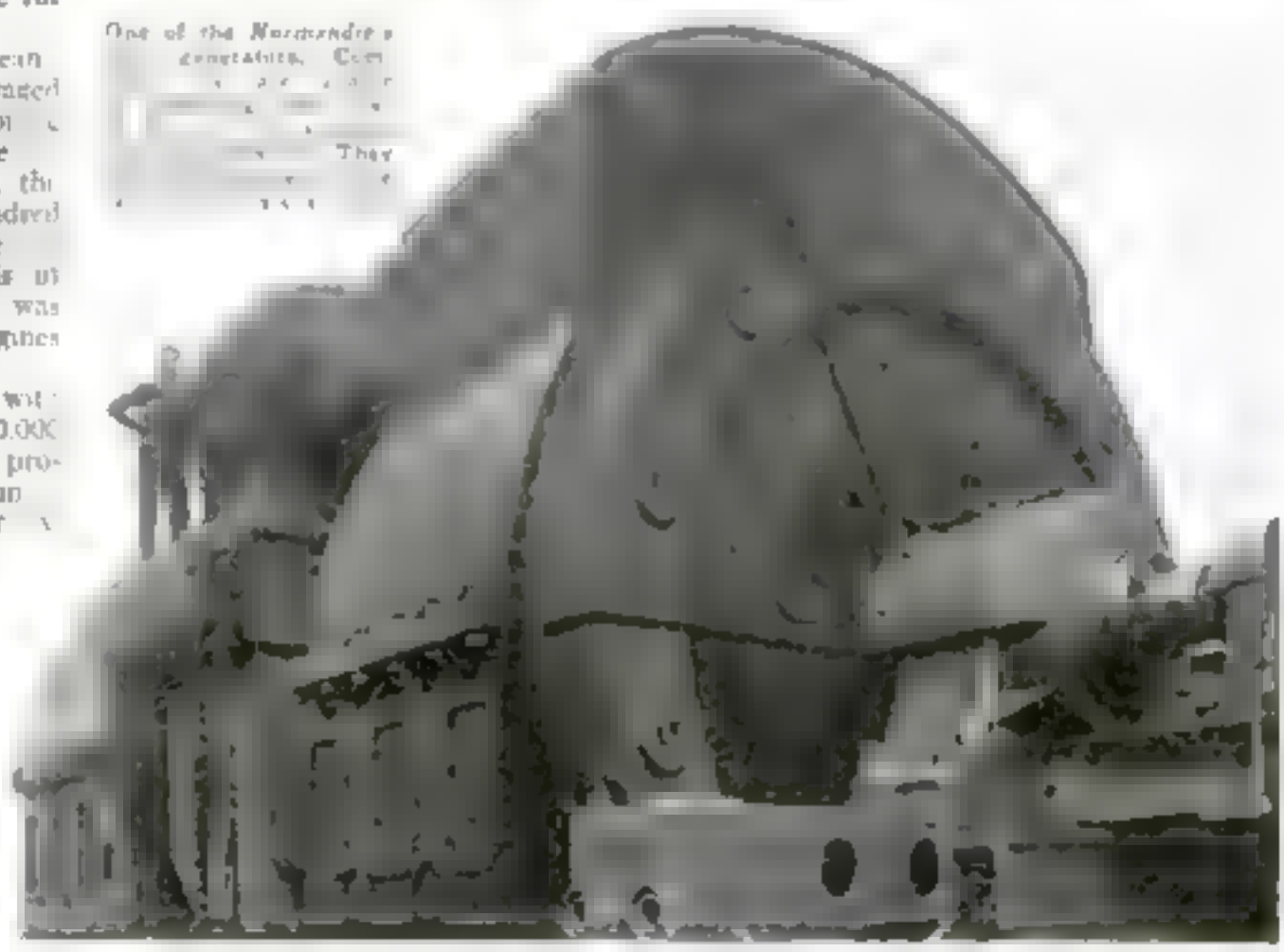
Engineers of the Alsthom Company, Belfort, France, in collaboration with the American General Electric Company, have been laboring for several years over the design and construction of what will be one of the largest and most nearly unique electrical systems ever built for operation on either land or sea.

TO DRIVE this monster ship, four motors had to be built, each more than twice as powerful as any motor used for any purpose on land, and more than seven times as powerful as the most powerful steam locomotive that was ever built.

To supply these giant motors with current required a still greater feat of engineering. Running at highest speed, they necessitated a generating plant capable of producing more electricity than the combined generating capacity of the 154 power stations in the entire states of North Dakota, Mississippi, Wyoming, Nevada, and Delaware. Four huge turbo-generators, with a maximum capacity of 42,750 kilowatts each, were finally constructed to meet this demand.

THEN came the problems of lighting, heating, cooling, ventilating, cooking, running elevators, operating winches and capstans, of providing current for hundreds of miscellaneous electrical devices needed for the safety and comfort of a great superliner. No modern hotel on land, no community, could boast such extensive electrification as had been planned for this ship. Merely to supply these auxiliaries, six additional turbo-generators, totalling 18,000 electrical horsepower, had to be included in the plans.

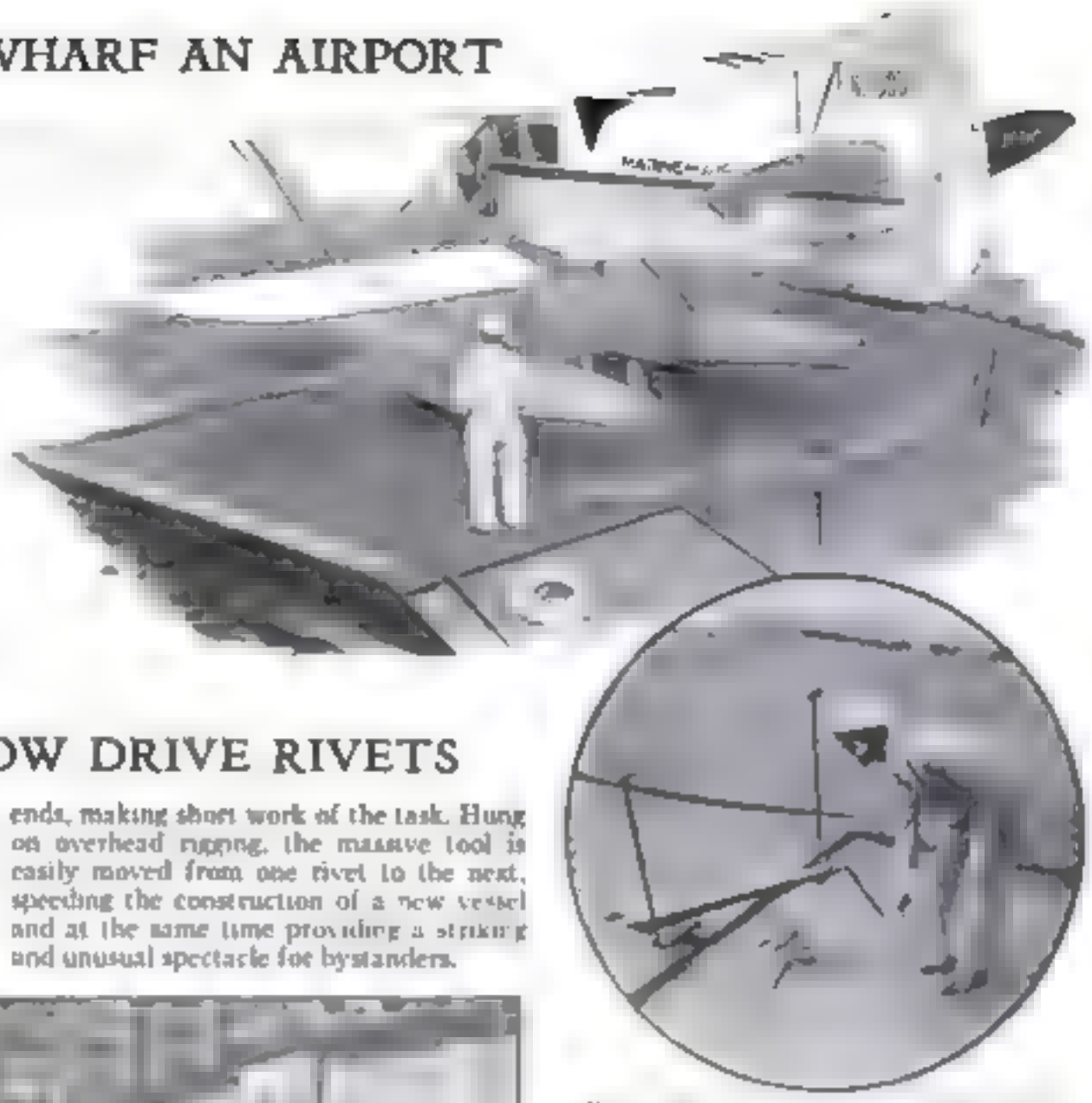
When the *Normandie* is ready for her first crossing, she will represent not only the triumph of the electric ship but also the most complex and complete utilization of electricity for human service in existence today. (Continued on page 108)



One of the *Normandie*'s [illegible] They

TURNTABLE MAKES WHARF AN AIRPORT

ANY wharf is transformed into an airport by the installation of a portable turntable for seaplanes, successfully tried out near New York City. The floating base of the turntable, which slopes down into the water, is attached to the end of the pier by rope hawsers. An arriving plane taxis up the platform and stops on the turntable, where it discharges its passengers. Then an attendant revolves the turntable with a hand crank and the plane, faced the other way, is ready to depart. A ticket office is installed at the land end of the float. Whenever desired, float, turntable, ticket office, and all may be towed away to a new location. Since so little space is needed for its installation, the portable turntable helps solve the problem of landing planes in congested sections of great cities that have the necessary harbor facilities.



Upper picture shows how a turntable enables a seaplane to land on a wharf and the lower view shows the table being turned until the machine can again take to the air

GIANT PINCERS NOW DRIVE RIVETS

DRIVING rivets instantly and silently is the style in modern shipyards. Instead of a clattering hammer, a huge pair of pincers, shaped like a lobster's claw and possessing a giant's strength, is used. Compressed air squeezes the jaws down upon the rivet-ends, making short work of the task. Hung on overhead rigging, the massive tool is easily moved from one rivet to the next, speeding the construction of a new vessel and at the same time providing a striking and unusual spectacle for bystanders.

These giant pincers, capable of exerting enormous pressure, are now used in shipyards to drive home rivets. The work, formerly done with hammers, is speeded up and is also noiseless

DEVELOP AIR PHOTOS WHILE PLANE FLIES

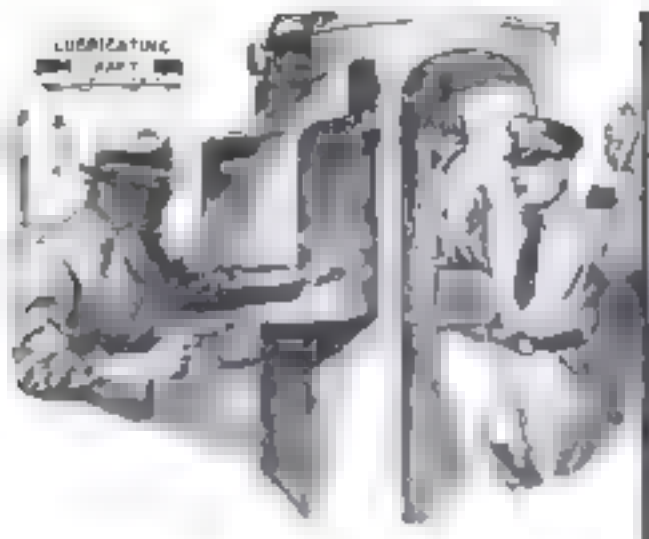
OPERATING in daylight and dispensing with the need of a darkroom, a new film-developing tank for U. S. Army aerial gunners enables them to develop films made by machine-gun cameras before returning to the base. Films made with these cameras, which resemble and are handled like machine guns, show the position of the "enemy" plane within a series of concentric circles. The new tank shows the gunner his score while he is still in the air.

A new developing tank makes it possible for U. S. Army flyers to develop films while in the air

ELECTRIC CAN OPENER SHEARS OFF THE TOP

EVEN the opening of cans is now a task performed by electricity. An electrical can opener exhibited not long ago at Cleveland, Ohio, is said to be capable of removing the tops of twenty one-gallon cans a minute, and of smaller ones at a faster rate. A knob is manipulated to bring the cutting edge against the top of the can, a contact is closed, and the motor-driven cutter shears off the lid in a jiffy without danger of injuring the fingers. The photograph at the left shows the electrical can opener in use. The lid is sheared off quickly while the can is revolving upon a table set at a convenient height beneath the cutter.

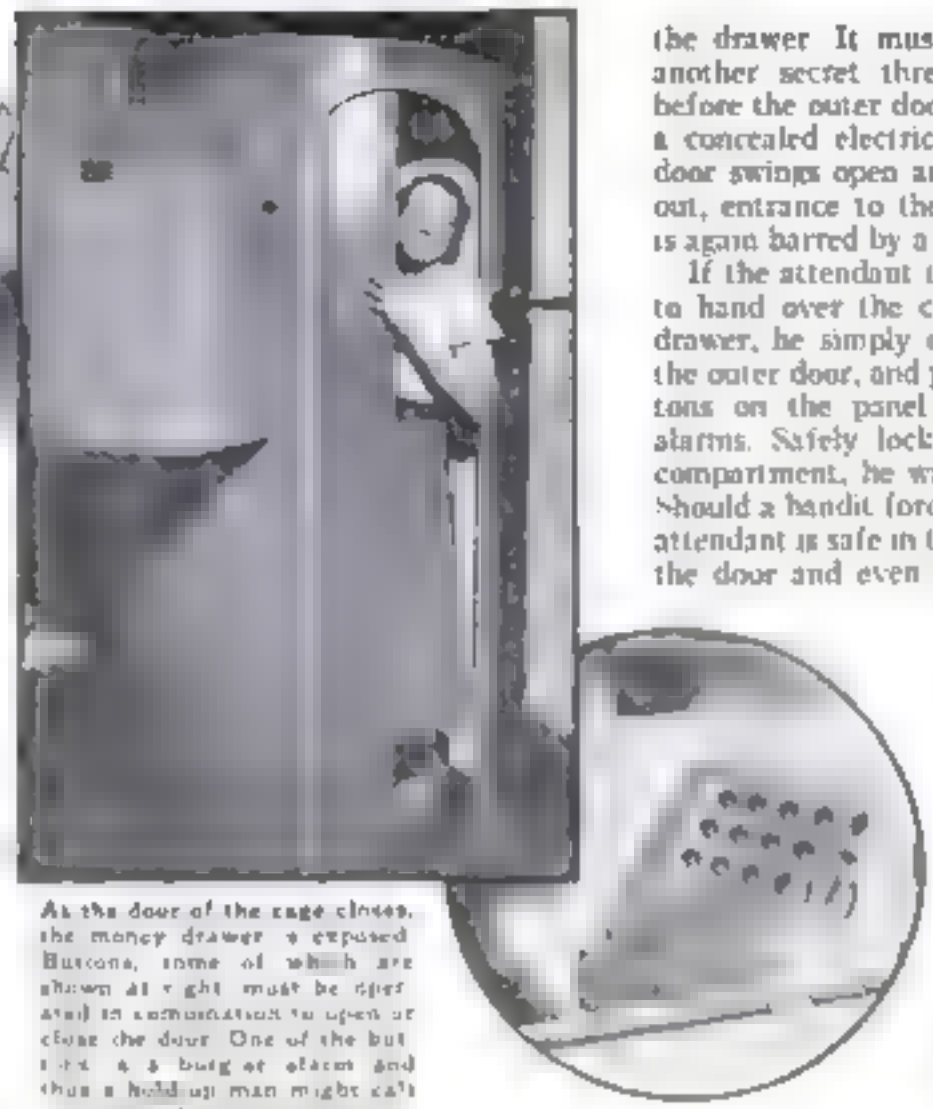
BULLET-PROOF STEEL INCLOSES NEW CAGE FOR CASHIERS



This electrically controlled bullet-proof cage for cashiers is not big enough for one person to enter

Electric locks foil hold-up men in a new cashier's cage for filling stations and small-town banks. Just large enough for one person to enter at a time, it is completely inclosed in bullet-proof steel and fits conveniently in a corner of a room. When the attendant enters to make change, cash a check, or leave a deposit, he presses an electric contact. The door glides shut and locks him in, simultaneously exposing the money drawer and fifteen numbered buttons on a panel above it. Pressing a certain combination of three buttons opens the drawer. It must be shut by pressing another secret three-button combination before the outer door can be re-opened by a concealed electric switch. As the outer door swings open and the attendant steps out, entrance to the money compartment is again barred by a metal curtain.

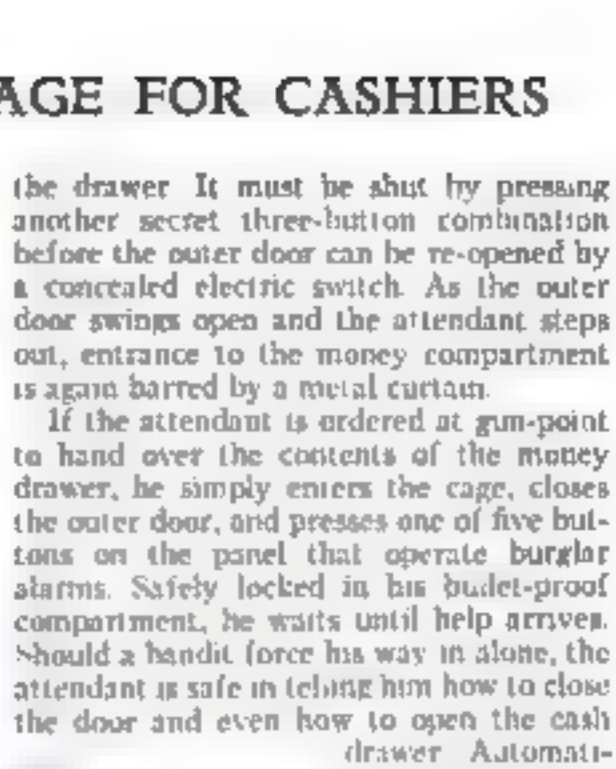
If the attendant is ordered at gun-point to hand over the contents of the money drawer, he simply enters the cage, closes the outer door, and presses one of five buttons on the panel that operate burglar alarms. Safely locked in his bullet-proof compartment, he waits until help arrives. Should a bandit force his way in alone, the attendant is safe in telling him how to close the door and even how to open the cash drawer. Automatically imprisoned, the thug can occupy himself guessing which button to press to close the money drawer and release himself. In trying he will himself operate the burglar alarm, meanwhile remaining locked in the cage from which he has no chance to make an escape.



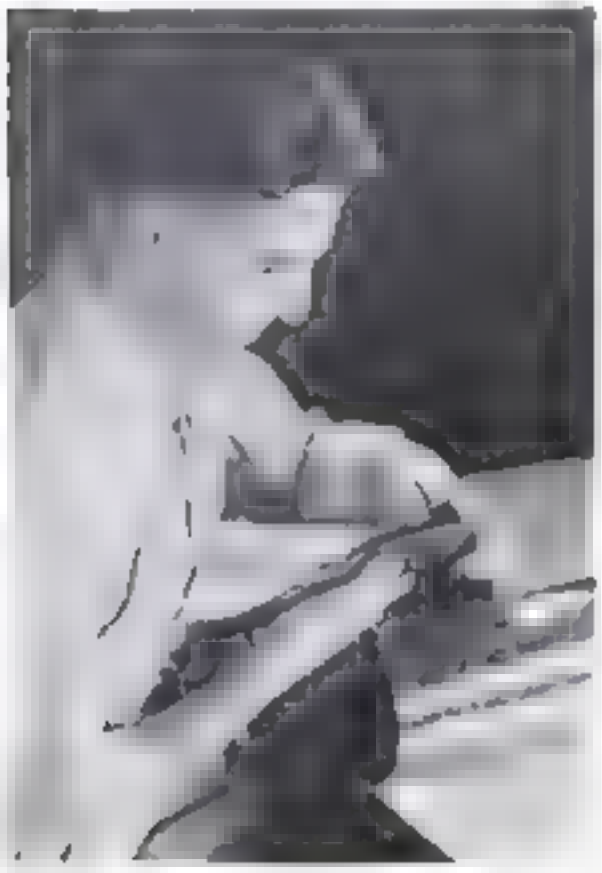
At the door of the cage closes, the money drawer is exposed. Buttons, some of which are shown at right, must be operated in combination to open or close the door. One of the buttons is a burglar alarm, and thus a hold-up man might call the police while trying to escape

CHEMICAL RAISES FIRE-HOSE PRESSURE

Boosting water pressure for fire-fighting purposes without the use of pumps was a feat demonstrated at Newark, N. J., the other day. The stunt, accomplished by placing chemicals in the water lines, is expected to prove a boon to firemen when combating blazes on the outskirts of cities and other districts where the water pressure drops too low to give the hose stream sufficient force and range. Cans of a foam-producing chemical are dumped into a portable hopper that is coupled into the hose line between hydrant and nozzle. The main stream of water passes through the U-shaped tubular base of the device, while chemicals from the hopper are injected into the stream by an auxiliary jet. In a recent test, the increased pressure thus obtained lengthened a hose stream from seventeen to sixty feet. In addition, the fire-smothering foam discharged, which is estimated to be about ten gallons of foam for one gallon of water, is much more effective in extinguishing a fire than water alone.

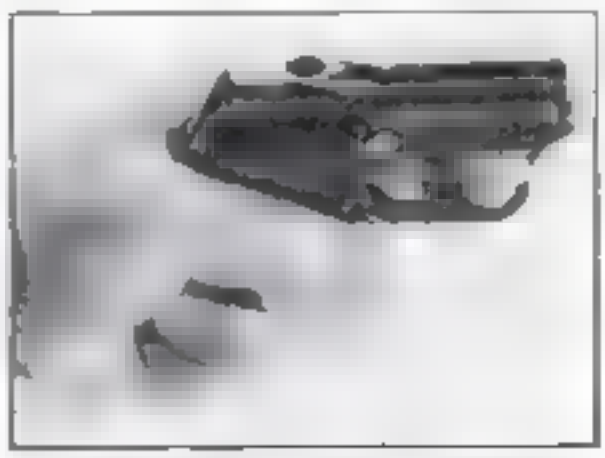


Into the hopper chemicals are poured and as the water in the fire hose gushes from the nozzle they raise the pressure and help in fighting flames



WATERPROOF PAPER IS COATED WITH COPPER

Waterproof paper coated with a thin layer of copper is now available for building purposes. The coppered paper is useful as flashing around windows and doors, and serves as an inexpensive substitute for ordinary sheet copper in many applications. Easy to work with, it may be cut with ordinary scissors. The thin copper face is formed by electrically depositing the copper from a bath. This sheet is then joined to the asphalt backing by a special process that is said to prevent peeling even when the flexible paper is bent and twisted.



A stage pistol that fires blank cartridges with a realistic report. Shells are automatically ejected

BLANK CARTRIDGE PISTOL FIRES REALISTIC SHOT

Designed for theatrical performances and for starting races, an improved type blank-cartridge pistol also serves for self protection in homes where a real gun would be considered dangerous. The appearance of the gun is sufficiently realistic to fool an audience, since it looks like a small automatic. A magazine beneath the barrel holds the blank cartridges, which after firing are automatically ejected through an aperture at the top by a spring mechanism.

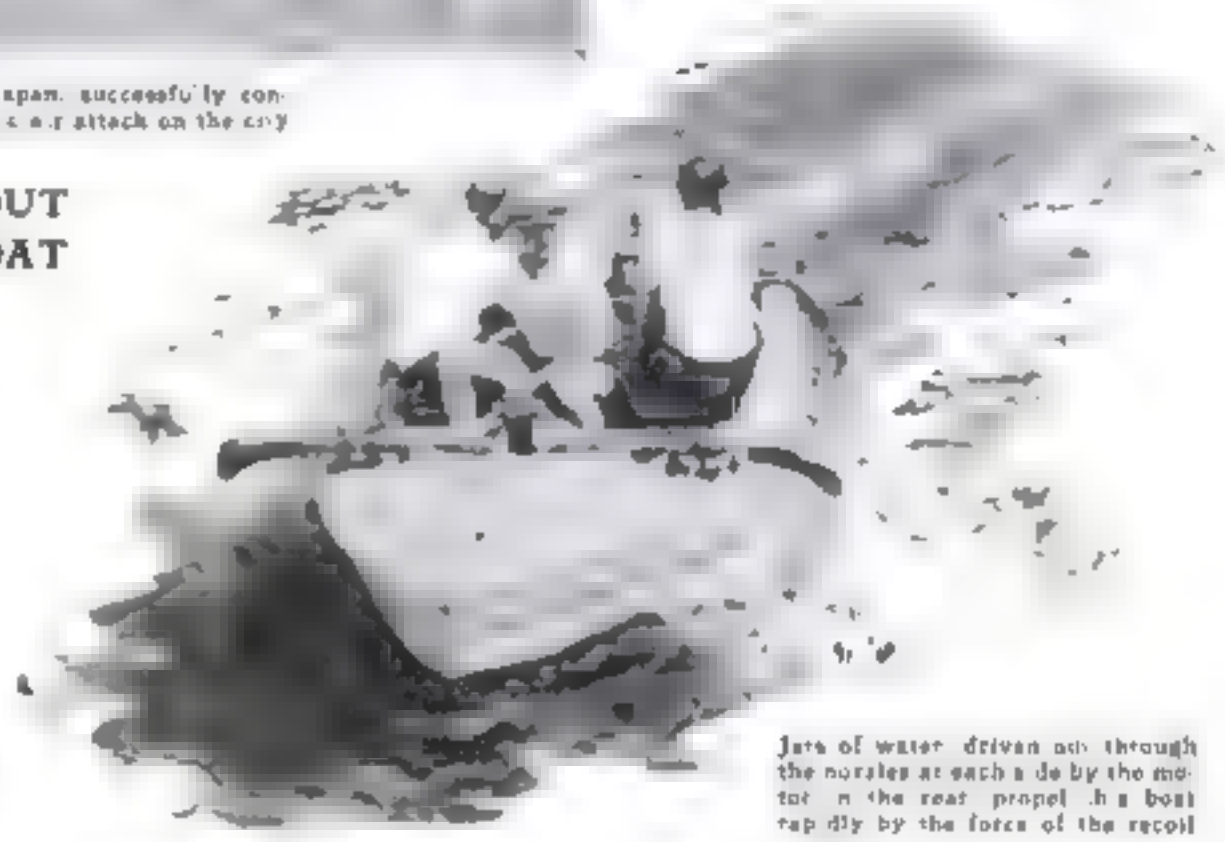
STRAW MATS HIDE CITY'S RESERVOIR FROM AIR RAIDERS

Straw mats, floating on the reservoir at Tokyo, Japan, successfully concealed it from bombing planes during a recent mock air attack on the city

When bombing airplanes roared at night over Tokyo, Japan, a few weeks ago, in a spectacular series of mimic air raids to train the civilian populace in self-protection, they found the city well prepared. All lights had been extinguished to hide familiar landmarks, and there was not even a glimmer of reflected moonlight from the municipal reservoir. The resourceful defenders had concealed the entire surface of the water with floating mats of straw, as shown in the photograph, so that it looked like dry land to the night raiders. By this means, observers foresee, a waterworks, an important strategic objective in wartime, could be hidden from bombing planes.

JETS OF WATER, HURLED OUT BY MOTOR, DRIVE THIS BOAT

Jets of water, spurting backward from nozzles at each side, drive an unusual craft that has just met its first tests successfully on the Vltava River near Prague, Czechoslovakia. Instead of turning a propeller the motor at the rear of the odd craft operates a pump that sucks up water and discharges it through the nozzles. As the water is forcibly hurled backward, the recoil propels the boat forward, much as a big gun recoils when a shell is fired. Since the jets are constantly in action, however, the driving force is continuous. Having no propeller protruding from the bottom, the boat can navigate in water so shallow that there is barely enough to float the hull. Tests showed the boat was economical and fast



Jets of water, driven out through the nozzles at each side by the motor in the rear, propel this boat rapidly by the force of the recoil

NEW PHOTOS PROVE INSECT-EATING PLANT CAN SMELL

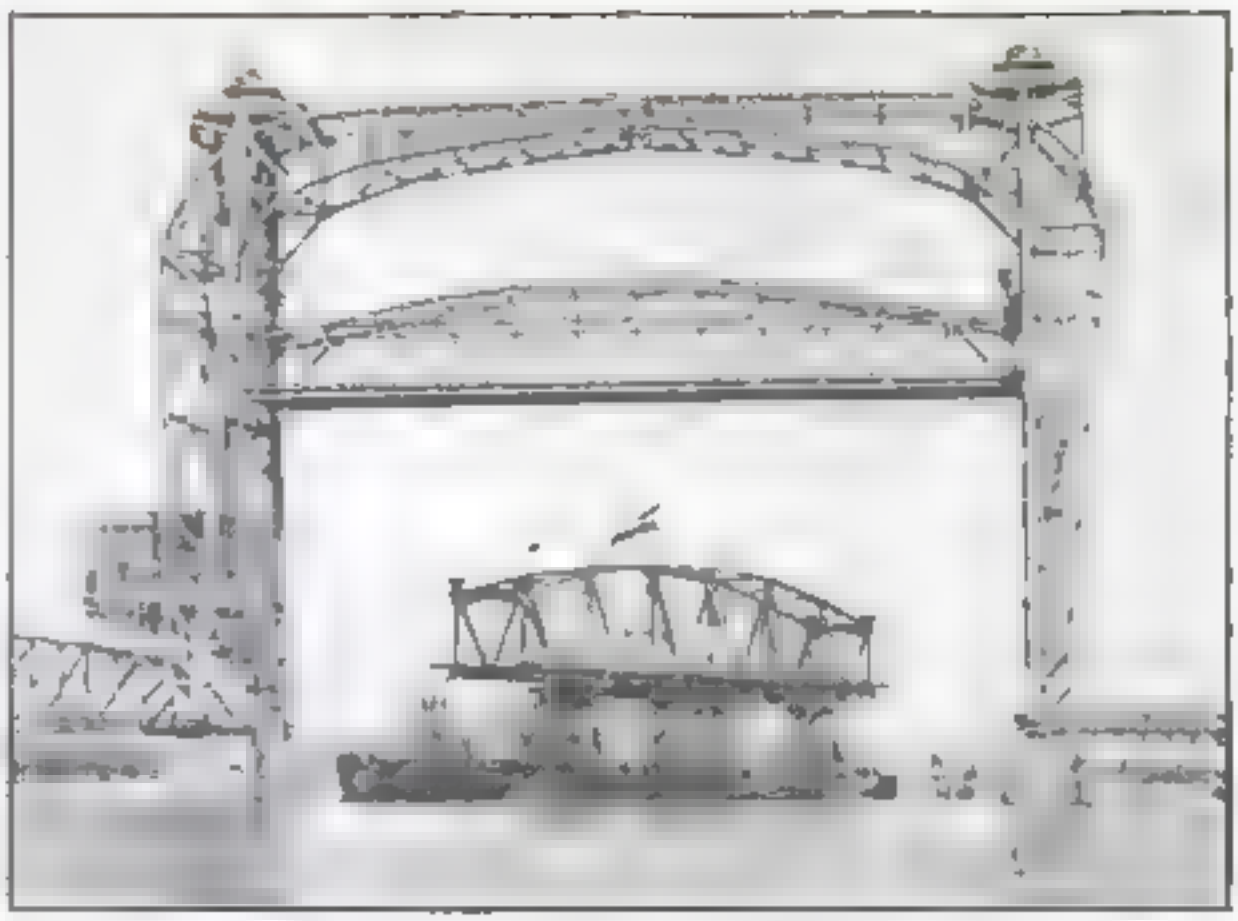
Believed the first of their kind ever made, photographs taken recently by a London experimenter offer convincing evidence to answer a long-disputed question: Have certain plants a sense of smell? The pictures show a sundew plant, an insect-eating or carnivorous species, deliberately reaching out and seizing a tiny bit of raw meat attached by a stiff hair to a needle, showing the amazing fact that the plant was definitely aware of its presence. While the movement was slow, it was plainly visible in exposures made at forty-minute intervals.

One of a number of plants that are known to trap insects, the sundew is a marsh-growing inhabitant of southern North America, Europe, India and China. Its leaf, about half an inch in diameter, is rimmed with red tentacles that close upon any insect attracted by a drop of nectar at the center. Glands in the leaf pour forth a fluid that digests the insect so that the plant can absorb its juices for food. That this plant could actually chase its prey, by moving toward it, has long been suspected but has awaited proof until now. In the experiment, the presence of the meat could be detected only by smell and therefore it is believed to prove that the sundew has this animal faculty, never before found in a plant.

The first picture shows a bit of raw meat suspended near a sundew leaf. In the second picture, note that the leaf has begun to incline toward the meat and in the third, the leaf has grasped its prey. This suggests that the plant has a sense of smell

NEW OXYGEN-BREATHING SYSTEM AIDS PATIENT

Much of the discomfort experienced in taking oxygen is removed by a new form of apparatus for administering the gas developed at the University of Wisconsin Medical School. While using it, the patient is able to talk, eat, and breathe with perfect ease. A long tube, shown in the nurse's right hand, is passed through the patient's nose to the throat, so that the oxygen may flow freely to the lungs. Provision is made for humidifying the gas before it reaches the patient.



ONE BRIDGE FLOATED UNDER ANOTHER

Villagers of Barendrecht, Holland, recently witnessed the unusual spectacle of one bridge passing under another. The meandering structure was built at a plant on the Meuse River at a point some distance upstream, and floated down the river to its permanent site. To reach this, it had to pass the vertical-lift bridge seen in the photograph above. The camera man snapped the striking view just as the bridge tender gave right-of-way to the unusual cargo and the new bridge, guided by tugboats, went by

ELECTRIC GUN THAWS RAIL SWITCHES

Resembling a large-scale counterpart of the electric-hair dryers used in homes and beauty shops, a portable, electric hot-air gun has been devised in Germany for thawing frozen railroad switches. When its metal guide is set astraddle of the rail and the current turned on, a blast of heated air quickly melts the ice and restores the switch to service. The current for the operation is taken from the nearest switchbox or directly from the trolley wire. The gun contains a blower and an electric-heating coil over which the air passes. The apparatus is so light that one man can carry it easily from place to place in a railroad yard. Another type of thawing gun is being developed to operate on the steam-power roads.

Powered by electricity, this portable hot-air gun has been developed in Germany for the purpose of thawing quickly frozen railway switches

NEW CIGARETTE PUT UP IN WATERPROOF PAPER

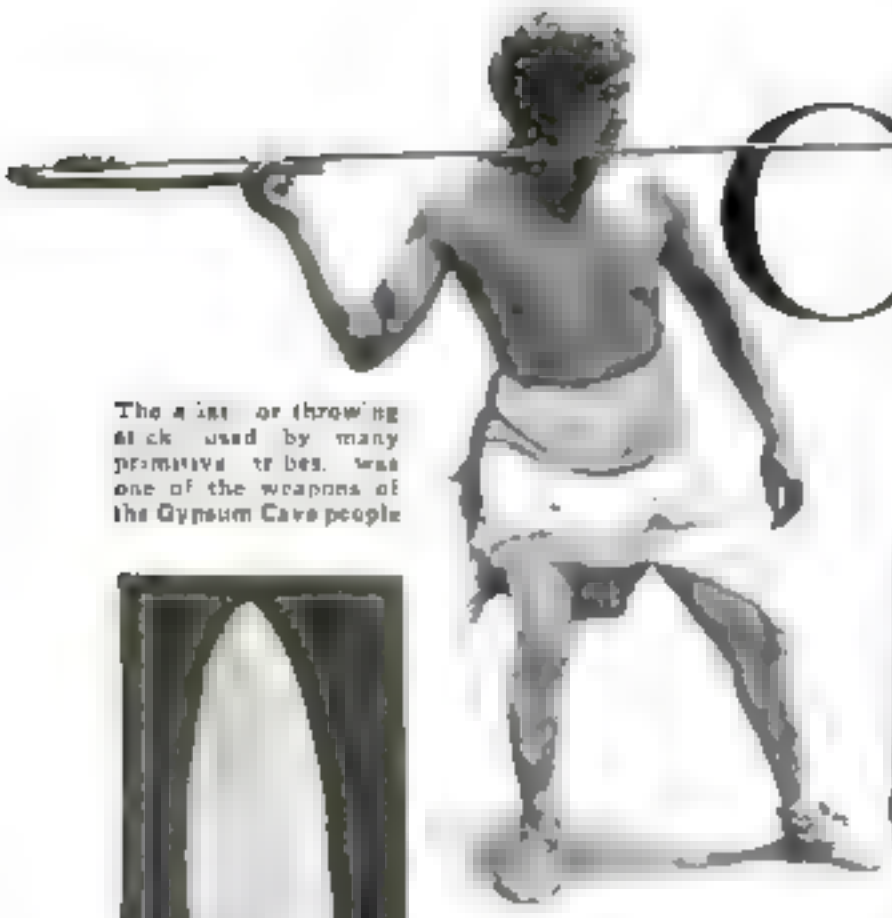
Accidental wetting does not harm cigarettes of a type just placed on the market, for the paper with which they are made is waterproof. In the test illustrated above, an experimenter held one of the new cigarettes in running water for three minutes. He then removed it and promptly smoked it as if nothing out of the ordinary had happened. Cigarettes made by the new process are said not to break apart at the tips from the moisture of the lips, a feature designed to appeal to smokers generally. Their waterproof characteristic, however, is expected to be especially popular among bathers and campers and in general they are designed to appeal to all who, for sport or work, are likely to be outdoors during inclement weather. The treatment to which the paper is subjected is said not to affect the aroma of the cigarette.

HAND PADDLES BOOST SPEED IN SWIMMING

To enable swimmers to make faster time with less effort, a New York inventor has devised a pair of disk-shaped aluminum paddles to be worn on the hands. In making a swimming stroke, the flat face of the disk is presented to the water, while it is turned edgewise or lifted out of the water on the return stroke. The paddles are attached to the wrists with adjustable straps, and the back of each is ribbed. The inventor declares he finds his own swimming speed greatly increased with his device and that it does not interfere with the use of any of the conventional swimming strokes.

NEW DISCOVERIES

Civilized Men



The atlatl or throwing stick used by many primitive tribes, was one of the weapons of the Gypsum Cave people

Ages ago some unknown artist scraped this picture of a ground sloth on a cliff near Moapa, Utah. It lived at the time of the ground sloth

Above, a stone knife shaped by a hunter of the sloth man and unearthed from beneath a rock slab. At right of it, atlatl darts found in Gypsum Cave. They were fashioned like arrow heads to the atlatl

By Robert E. Martin

ARTISTS of the desert, intelligent human beings in a fair stage of civilization, lived in Nevada about 15,000 years ago.

They hunted down huge ground sloths long since extinct and llamalike camels and native horses that had disappeared ages before Columbus sailed from Spain. They killed these creatures with darts propelled from atlatls, cooked their meals over fires whose smoke blackened the walls of their cave dwellings. They decorated their dart shafts with color-fast pigments and preserved their foods in natural refrigerators dug with pointed sticks in deep caves. They lived thus when at least thirteen types of large animals, now all extinct, were roaming the wilds of Nevada.

From the dark recesses of Gypsum Cave in western Nevada, Mark Raymond Harrington of the Southwest Museum, has definitely extended the horizon of America's human history back over 10,000 years beyond the Basketmakers who lived 3,500 years ago. Man lived here before the ground sloths disappeared, for Harrington has found remains of his fires and his weapons and tools below the remains of the sloths, camels, and extinct horses. So nearly perfect are these relics that a whole basketful of sloth hair has been recovered in almost perfect condition.

Gypsum Cave has revealed no skeletal remains of these sloth men, but it has given the world its first evidence of this race and leaves no doubt that man lived in the desert region of Nevada nearly 15,000 years ago. We do not yet know his physical characteristics, nor the intimate details of his life, but the fact of his existence has been indisputably proved.

For nearly two years, Harrington and other members of the Southwest Museum-Sessions expedition, in which the California Institute of Technology and the Carnegie Institution participated, explored the five rooms of the large cave. Over treacherous rockslides and through low openings, he penetrated its depths.

Near the entrance he picked up a few evidences of relatively modern Indians, in the inner chambers he found a few pieces of atlatl darts of Basketmaker type, until recently the oldest known race in North America. Later he found abundant evidence of the sloth man.

Among other scientific treasures he found the complete skull of a ground sloth, the dessicated form of a rattle snake and bones of camels and native horses. Finally he uncovered abandoned fires and painted dart shafts, points for atlatl darts and a flint knife, worked sticks and camel bones from which the marrow had been stripped. All of these things he found beneath solid layers of sloth dung. Thus he proved that human beings had lived here long before the ground sloths disappeared from the face of the earth.

Many people, miners and Indians and pleasure seekers, had stumbled over these valuable remains, little suspecting that within the cave lay a hundred golden keys ready to unlock the door leading to the dim past. Gypsum Cave, sixteen miles east of Las Vegas, near Hoover Dam, lies in a limestone spur of the Frenchman Mountains. Its entrance is fifteen feet high and seventy feet wide and the cave measures 300 feet in length. It had been long known to the Piute Indians. The Piutes, by their own account, considered

Mark Raymond Harrington, of the Southwest Museum, is standing at the entrance of Gypsum Cave, Nevada. In this cave he found the remains of strange animals and tools shaped by men who lived in that region 15,000 years ago when ground sloths and native horses, long extinct, were still living

INDICATE AMERICA HAD

15,000 Years Ago

This bone, th teen inches in length, is from the front leg of a [illegible] beast not in Ame ica for 10,000 years

[illegible] They [illegible] AW and hair which was in good condition

[illegible] bones found in Gypsum [illegible]

[illegible] rate measures of [illegible] nd tell us more of what has occurred sinc [illegible] used the cave as a retreat. Since the cave and surrounding country are dry these specimens would be preserved [illegible]

Down through four layers of dust, shes, rocks, general refuse, brown earth nd animal deposits they dug and in the fth layer they [illegible] ngle stroke ca [illegible] of 3,500 years ago as a modern race and bring us to the time when the sloth men visited Gypsum Cave. Three layers of deposits separate the sloth men from the basketmaker.

What gave layer five its special interest were the traces of the ground sloth. Scorched charcoal which could have come from no source but man, and at no time except the ground sloth period, was present, as well as traces of two campfires, an oval scraper knife of chert, and two worked sticks. Manufactured prod[illegible] de by an unknown race o[illegible]

Throughout his investigations, Harrington uncovered artifacts and bones of the two periods, but none identified as belonging to the 10,000-year period between.

As Harrington's researches advanced from one room of the cave to another he piled up what he considers positive evidence of the existence of the sloth man. Bits of cane, burned at the ends as if from use as a torch, lay beside the bones of a baby sloth; several sticks, burned at one end, were found below an unbroken layer of sloth dung; a wooden foreshaft for an atlatl dart lay beneath a similar layer while a piece of polished wooden dart shaft lay embedded in such a layer; a stone dart point was embedded between two burned layers. In the same layer was a sloth leg bone, and nearby were found bones from a slender species of camel. Elsewhere a stone dart point and above it the nearly perfect sloth skull while in another room, painted dartshafts were found below a layer containing sloth dung and hair. A worked *(Continued on page 106)*

the cave a sacred place and their medicine men deposited offerings in it. To the whites, it has been only a picnic ground.

In exploring the cave, Harrington found his work impeded by many tons of rocks that had been shaken loose from the roof by an earthquake thousands of years ago. Yet soon after the work started, one of his assistants, Mrs. Bertha Parker Thurston, discovered the skull of a strange animal which later was identified as that of a ground sloth.

Soon others found the bones and hair, possibly belonging to the same animal. Later the searchers unearthed the distinct remains of a campfire, nearly eight feet below the surface of the ground and underneath two unbroken layers of sloth dung deposited many ages ago.

How were these things, particularly pieces of wood and hair from extinct sloths, preserved through the rains and snows of thousands of years?

In order to understand," Harrington explained, "a general description of the deposits and the manner in which they were laid down will be necessary.

"Originally the cave must have been a great crevice formed by solution of the limestone by percolating waters of an acid character. Where the limestone was softer, more was dissolved, forming the five rooms of the cave. Deposits, embedding bones of Pleistocene camels and horses, were laid down as gravels, sands, and silts were washed in by water flooding in from the entrance.

"As the climate grew drier, these deposits finally stopped. Thenceforth deposits within the cave consisted only of rock fragments which fell from the roof, dust blown in from the outside, and deposits of animal origin. In brief, most of the floor deposits in the inner chambers were formed before the coming of the sloths. The outer deposits give us our most ac-

STRANGE INVENTIONS *used by* Crooked Gamblers

By Thomas M. Johnson

IT WAS after midnight at Saratoga Springs, N. Y.

Dark and silent, a large residence on a side street stood apparently deserted. Its shutters were closed, its blinds drawn. But inside, were brilliant lights and the tense atmosphere of the gambling hall. Men and women leaned over green-topped tables and a tide of chips and currency ebbed and flowed according to the caprice of various games of chance.

At the far end of the room, a big man shoved his pile of colored chips to the center of the table.

"I'll bet the works, five grand more," he challenged. "Who'll cover my bet?"

There was an angry murmur of dissent.

"There you go!" growled another player. "Can't cha remember there's a limit in this house?"

The big man pushed back his chair sharply.

"I'm sick of this piking place and its limit. I want action! I'll find some place where the sky's the limit!"

He strode angrily to the door, slammed it behind him. Another man followed him out.

"Say, friend," he said, "I'm as sick of this piker joint as you are. Come on with me. I know a place where we can get real action."

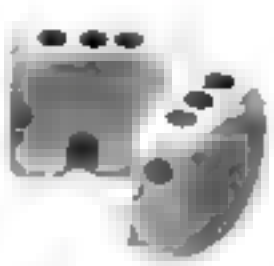
Fifteen minutes later, they were playing in a hotel room, no limit and for cash, with two cordial, well-dressed strangers. Dawn found the big man several thousand dollars ahead. Sure, he said, he would play again tomorrow evening.

The next night, his luck started well, but changed. Sometimes he won, sometimes he lost. Whenever there was a big pot he seemed to lose. Finally he got an exceptionally good hand. Masking his eagerness to make a killing, he worked the bets up to $15,000, putting everything he had into the pot. Then he threw down his hand. Four kings! The player opposite spread his cards on the table. Four aces! The big man's mouth sagged open.

Suddenly a rending crash shattered the door. In the opening stood bulky figures, pistols drawn in a threatening manner.

"Put 'em up, you three," they commanded. "We're from New York Headquarters. Then to the big man: "Not you, buddy. You're just a sucker. Look up there and you'll understand."

High on the wall behind his

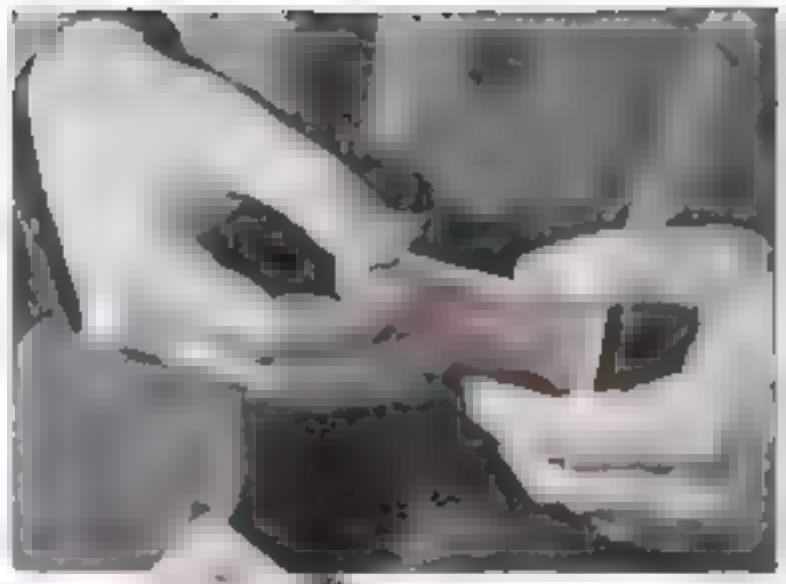


Cut in two, this die shows how weight can be added so it falls as is desired

The elaborate layout, ... peep hole, ... ric light sig- ... used in a ... on to rob a ... a big-stake ... poker 5 goals ... y a confeder- ... ed what cards ... a was holding

It was in this hotel room that the crooked layout, illustrated at top of page, was used. Picture was taken by the police who raided the game

MIRRORS, LIGHTS, AND MAGNETIC DICE HELP THE SHARKS FLEECE STRANGERS IN GAMES OF CHANCE



Hidden within his [illegible] the crook has the mechanical holdout shown at right. As he spreads his knees, the holdout delivers card to him. A lower right close-up of [illegible]

Cards are marked in various ways. Those shown here are identified by changes that have been made in the figures making up the design at the top. Below, an enlarged view of one loaded

seat, the big man beheld a tiny opening, just large enough for a peep hole. Leaning against the same wall on a side table, he had noticed an innocent-looking package. Now through its brown wrapping paper, he saw glowing in electric lights a horizontal row of four K s

Another door burst open and a detective dragged in a stranger

"Here's the guy that stood on the table in the next room, spotted your hand through the peep hole, and flashed the dope to his pals by that electric annunciator hidden in the fake package," the detective announced. He tore off the wrapper

See how it s fixed? Four rows of lights, each representing a suit and each row having thirteen numbers and letters, one for each card, arranged like this: A 2 3 4 5 6 7 8 9 10 J Q K. To signal his pals you had four kings, all he had to do was to flash the K for al four suits If they could h have beaten that, they would have dropped out. But they could. So they let you bet your shirt. They always knew what you had. You couldn't win—unless they let you and that wouldn't be often

Which climax. Lieut Grover Brown who engineered the arrest, caps with this statement

They worked that game not just at Saratoga but at twenty-two different race track and resort towns. They had peep holes hidden in the walls of hotels in each place and they would make reservations for the doctored suites far in advance The wired-up annunciator worked as well for bridge as for poker Skipping around the country they cleaned up a fortune—trimming suckers by every

I learned recently from my friends among the police signals flashed from packages by [illegible] is but one of many ways in which science is now used by crooked gamblers With electromagnets controlling the rod of dice with specially impregnated invisible ink marking the [illegible] sticks of cards as well as with new [illegible] of dash boxes and chuck [illegible] and gloves, they are fleecing the unwary

A sidelight upon the extent to which such gaming is carried on is the fact that one concern, devoted to the manufacture of crooked gambling equipment, has branch offices in Chicago Ill. Detroit Mich., Kansas City, Mo., and San Francisco, Calif., as well as headquarters in New York City. It employs expert chemists and mechanics in a special research laboratory to develop new aids for the dishonest gambler Purchasers order by code, "cube," for instance, standing for dice and "paint" for cards

Another concern in the same business distributes a catalog through the mails about the guise of a book exposing the evils of gambling Each crooked device described and illustrated is given a number. Accompanying the book, is a separate sheet. It lists the numbers with a price after each. Orders are sent in by telegraph, thus avoiding conflict with the postal laws.

Even so simple a gambling proposition as spinning or flipping a coin is made crooked by relatively common alterations now being made in underworld workshops. There are on the market coins with beveled edges sure to stop spinning and fall with the high side uppermost. Again, dollars are sometimes sawed in half and the two heads and the two tails sweated together in such a way that the line of joining is practically invisible. They are substituted for genuine coins by the cheaters during play. Whichever side comes up, the result is the same.

Not long ago, in a western city, police raided a gambling joint and confiscated among other things, a crap stick that had won thousands of dollars for the house Such sticks, made of rattan and curved at the end, are used to rake the dice back after they have been thrown upon the table When an officer accidentally twisted the handle of this stick, the secret of the

In th s picture, you can see exact y how the mechanism used in the hotel room was installed and operated. Note the package inside which the signal lights were flashed. Also the wires that connected it w th keys in the adjoin ng room so that it could be worked by the peeping confederate

Mirrors play their part in the crook's life. At left, is a ring in which a tiny mirror is so set that cards can be seen as they are dealt. Below, a matchbox in the end of which is a hidden mirror that gives the "glim" man a view of cards

players' ill luck at this table became apparent and very simple to explain to the victims

Inside was a secret compartment just large enough to hold two pair of dice, one pair normal, the other loaded to roll as the operator of the game wished. By a slight pressure of the hand, he could push the dice he held in his fingers into the compartment and receive the other dice in his palm without making a movement that would betray him. By this ruse, whenever the time was ripe, he supplied the patrons of the game with dice by which it was impossible to throw a winning point

Tap dice accomplish much the same result. They contain a small weight which can be made to shift to and from the center. Tap them on the table one way and they are loaded; tap them another way and they are honest. In this manner the crook loads the dice for himself and unloads them for his opponent

Another dodge of the dice manipulator I learned, is to hollow out one side of the cube just enough to make it slightly concave. The suction thus produced is sufficient to throw the odds to the one who lets the dice will land with this side down. Again, special dice, known as horses or tops and bottoms, are made with the spots on two or more sides identical. As only three sides of the cube can be seen at a time, when it is on the table, the trick is not noticed and the odds are all with the cheater who substitutes horses for his throws.

Recently, underworld chemists have produced a new aid for the gyp dicer. It is a transparent, quick-drying dice fluid. With it, one side of the cube can be coated to increase its weight. This coating cannot be seen and it is so hard a fingernail will not dent it

Of all these ruses for cheating at dice the most elaborate is the electromagnetic table. Underneath it are hidden small electromagnets that can be turned on or off by a knee or foot lever. When they are on, they attract bits of metal in the dice, causing them to stop as the player desires. He switches the magnets on and off according to whether he or his opponent is rolling.

Because non-metallic weights are put opposite the metal bits, the cubes are in perfect balance and will pass the common tests for loaded dice, spinning on one corner without wabbling and dropping into a long pitcher of water without having

Dice loaded with metal are made to fall with the desired number up by means of a magnet that is concealed beneath the table

the same number come up repeatedly. However, a small pocket magnet will stick to the side containing the metal and will thus expose the electric dice

A few years ago, the captain of a transatlantic liner became suspicious that marked cards were being used by certain players who were cleaning up in the smoking rooms. He put a detective on watch. As a result, one of the most carefully-planned gambling plots on record was exposed and the crooks arrested.

Frequently during play, the men would call for a fresh pack of cards. These were always supplied by the steward from those manufactured especially for the steamship line. There was no possibility of the cards having been marked on shipboard or after they were delivered to the players. Yet the men obviously were reading the hands of their opponents.

Sure of this, the captain had them locked in their rooms and questioned. Eventually, the secret of their winnings came out. It seems that the players were members of a ring operating exclusively on the liners of this one company. Posing as a manufacturer, the head of the ring had offered to supply the line with cards at one-half the price being paid. The purchasing agent had accepted without suspicion and the cards, which had secret marks placed in the designs on the back, were sold on all the liners. Only the ring members knew the

With this delicate machine the shark can trim almost any edge, cut off the corner of cards. Then he can identify them by touch

With the projecting knob on this ring cards are marked by indenting them so the crook's fingers can find them instantly

marks and, by buying fresh packs direct from the steward, they had completely disarmed the suspicions of their opponents who were being fleeced

Almost every playing card on the market has an elaborate design stamped on the back. Altering such designs to mark cards has become a regular art. Special inks which do not upset the gloss of the card are now available. They are supplied in the exact shade and chemical composition to match the ink originally used in printing the cards. In other cases, after lines have been shaded or spaces altered, the cards are repolished with a fine grade of chamois skin and vaseline ending with a final rubdown with powdered boric acid.

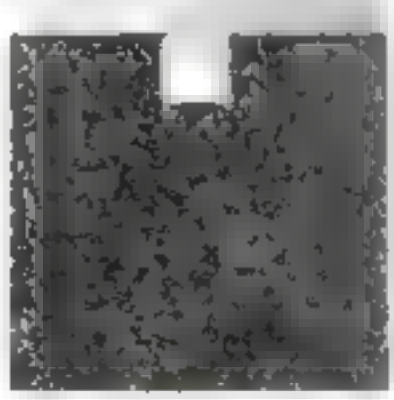
One company employs a dozen pen and ink experts to alter cards to order, to produce "readers" for its clientele. Another concern prints a complete line of imitations of popular brands of cards, with minute give-away variations in the designs on the backs. One such deck, on the market for the use of tricksters, is advertised as having a total of 12 000 combinations of secret markings in its design, which the initiated easily read.

Often professional card sharks work out private keys and secret codes for marking cards which would require hours for a suspicious opponent to decipher. Typical of the pains to which the crooked gambler goes in his efforts to defraud is a case reported from Chicago.

Here a sharper spent weeks in producing a "natural" deck of readers. Buying nearly 100 decks of a well-known brand of cards, having a diamond criss-cross design on the back, he sorted them over day after day, noting tiny variations along the top edge *(Continued on page 105)*

WHITE PAINT IS NEW WEAPON IN

War on Barnacles



Black and white tiles used in studying color effect on barnacles. Tests showed they were attracted by the black

BARNACLES, those tiny water growths that cost American shipping more than $ 00 000 00 every year, are now in the scientific spotlight. Through novel tests and intensive under-sea searches, experts hope to banish this costly pe

For more than three years Dr. F Pau Visscher of Western Reserve University has been studying the barnacle in its natural habitat, Trip were made, the hulls of han- inspected, and thousands of specimens collected. During his studies, he has found and identified more than twenty-five types of barnacles. Some are smaller than a pinhead, others larger than a pigeon egg.

Dr. Visscher's battle against the barnacle marks the resumption of an age-old fight. For centuries these hard-shelled creatures have fastened themselves to ships' hulls and ridden free, steaming power and consuming speed. In tests, a barnacle-infested hull often wasted as much as one-third of a ship's fuel supply.

Mariners the world over have tried them and keep hull free of the- On small ships, barnacle -en weighs hundreds of pounds. Occasionally, a vessel is found whose exterior cargo weighs more than three hundred tons. To remove this outer skin, the ship must be drydocked, scraped by hand, and finally repainted. In the case of giant ships such as the *Leviathan*, this procedure, a semi-annual occurrence, costs its owners more than $50,000.

During one of his adventurous trips below the sea, Dr. Visscher noticed a peculiar fact. Dark objects in shaded, under-water dells invariably harbored larger barnacle grow ls than rocks and surfaces higher color. Barnacles, it seemed, like dark

The investigator placed simple specimens of the test woo s ng the ocean bed near his seaside laboratory. Some te panels were painted w o e a few red and others black. After seven days, the test panels were removed and the barnacles that had -ed were grouped, identified, and -d. In each case the growth fastened -s on-fourths bered those on the ight er surfaces. The red panel contained more barnacles than the white and the black as many as the red, thus proving a color preference.

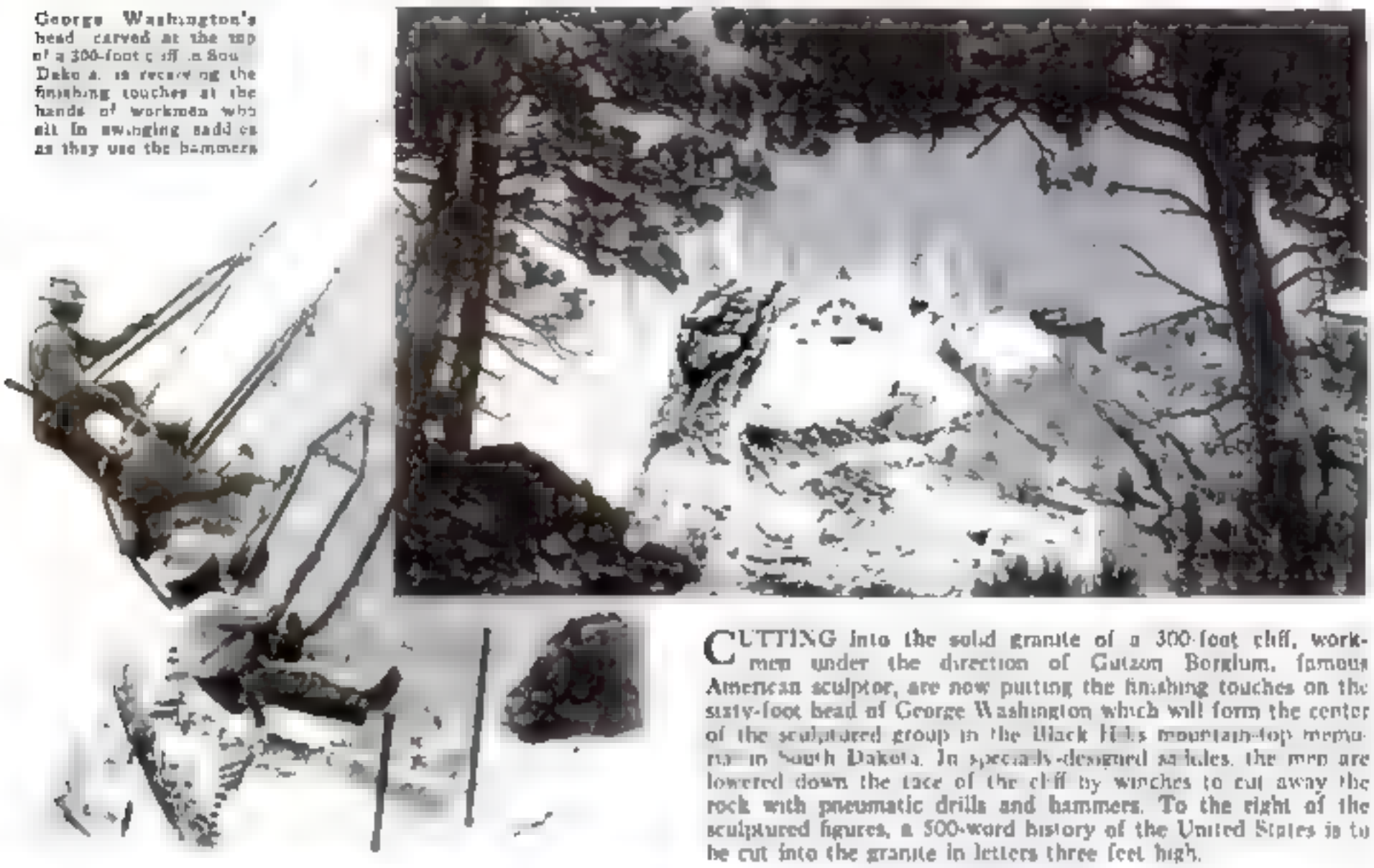
Later Dr. Visscher experimented with various paints. Panels of wood and tin coated with ar- -al paints were placed in sea water near the native colonies. In thirty days, the test panels were almost entirely coated with barnacle al- s. Only through the use of light-colored surfaces was the accumulation of barnacles eliminated.

Laboratory tests produced -t salts. T the young barnacle, t was found al- though susceptible to the blue-green light of the spectrum are not affected by the ultra-violet portion. In the blue-green glow under the surface of the sea, young barnacles shun the light and prefer the dark objects.

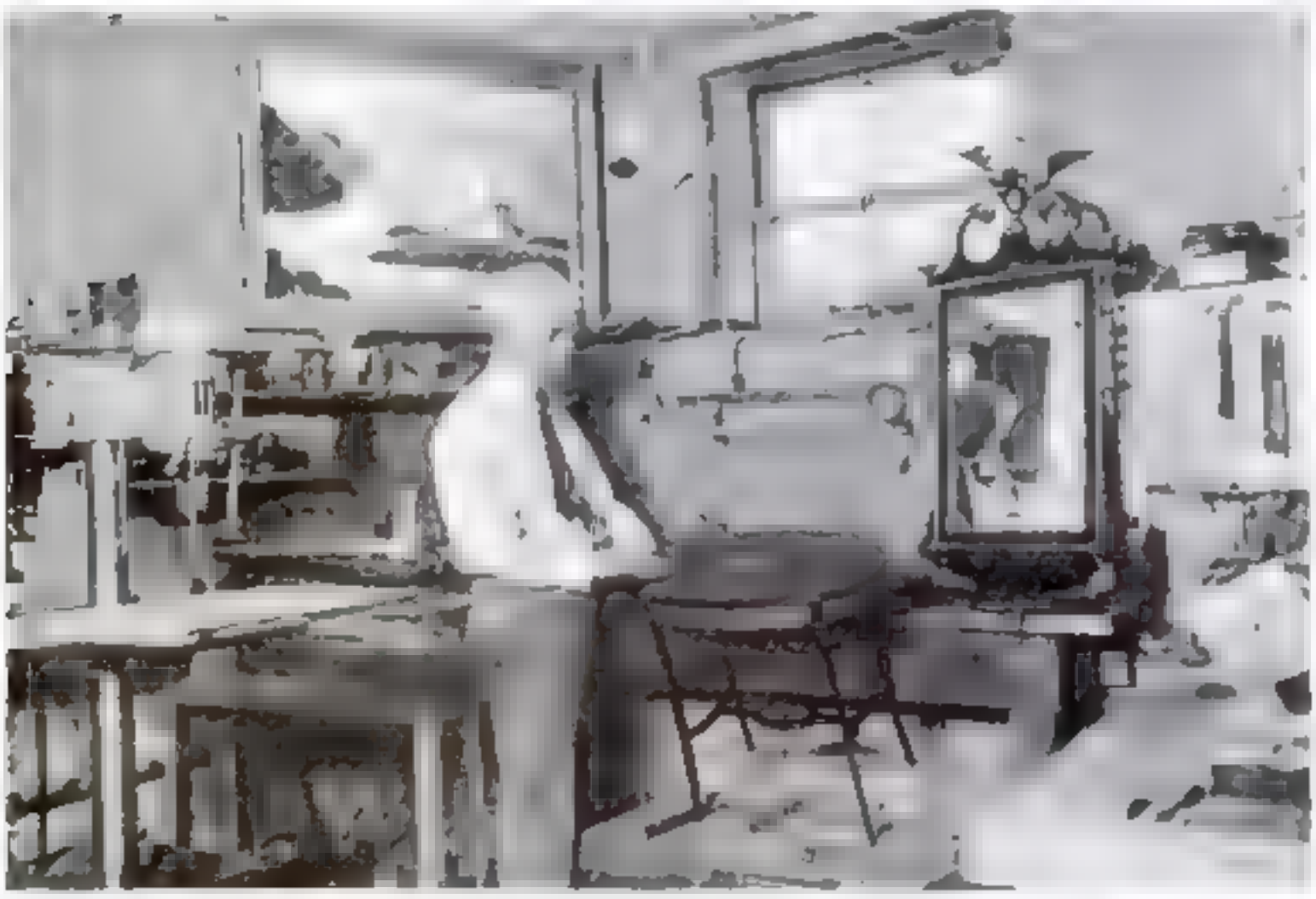
Thus science has laid plans for an attack on barnacles. Now chemists and paint experts are striving to develop light-colored paints that will stand up in salt water and soon, white-hulled ships may rob the barnacle of its costly sting.

Gigantic Carved Head Nears Completion

George Washington's head carved at the top of a 300-foot cliff in South Dakota, is receiving the finishing touches at the hands of workmen who sit in swinging saddles as they use the hammers



CUTTING into the solid granite of a 300-foot cliff, workmen under the direction of Gutzon Borglum, famous American sculptor, are now putting the finishing touches on the sixty-foot head of George Washington which will form the center of the sculptured group in the Black Hills mountain-top memorial in South Dakota. In specially-designed saddles, the men are lowered down the face of the cliff by winches to cut away the rock with pneumatic drills and hammers. To the right of the sculptured figures, a 500-word history of the United States is to be cut into the granite in letters three feet high.

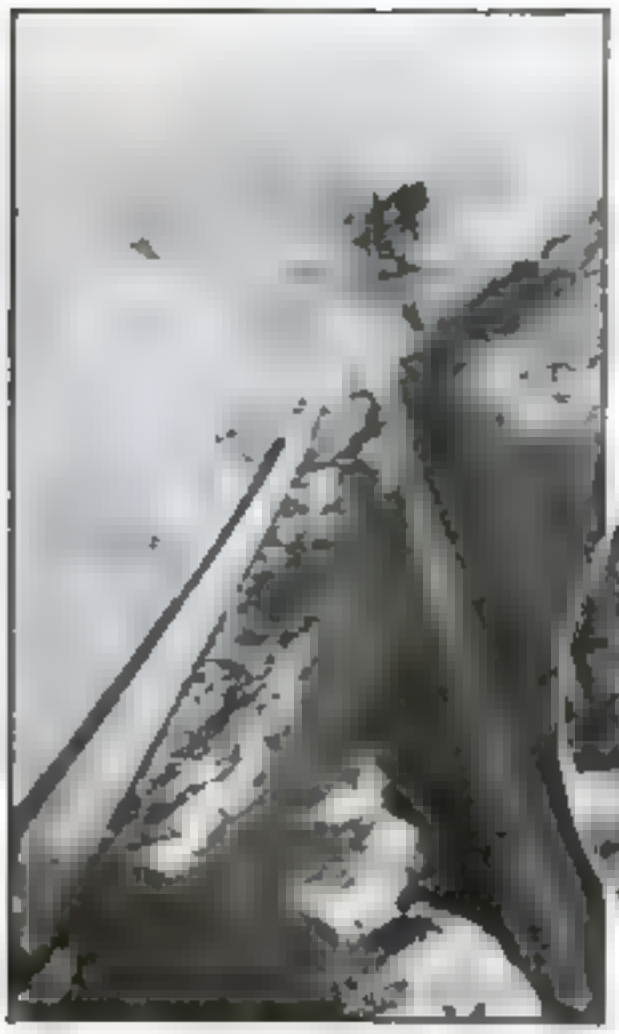


Work with Lathe is Hobby of this State Official

Everett E. Stone, of the Massachusetts Public Utilities Commission spends his leisure time in workshop

BUILDING inlaid mahogany tables, reproducing antique carved mirrors and working with tools in his home workshop, is the road to relaxation followed by Everett E. Stone, a member of the Massachusetts Public Utilities Commission and former mayor of Springfield. In the basement of his Brookline home, he has installed a lathe, a circular saw, an upright drill, a jig saw, a planer and other apparatus to aid him in his hobby. One corner of his workroom, together with a table and a mirror he has just finished, is shown in the photograph. All of the inlays were made with painstaking care, the coloring and shading being accomplished in hot sand. Painting marine scenes in oils is another of the diversions of the commissioner, the canvases being held in frames designed and made by himself in his own workshop.

OIL PIPE LINE CROSSES PALESTINE



[redacted] points, the line descends into valleys more than 300 feet below sea level and at others has to rise over mountains. [redacted] ted that the twin ten-inch [redacted] he line will transport 30,000,- [redacted] of oil a year In spite of dust storms, heat, and the rugged nature of the country, gangs of welders have been laying as much as four miles of pipe in an eight-hour shift. Many American methods are in use. Iraq, formerly Mesopotamia, is the site of some of the world's richest oil fields and the new pipe line will cut the cost of getting this oil to outside markets

[redacted]

Natives of Palestine watch with interest the work of the crew as the joints of new Iraq pipe line are laid

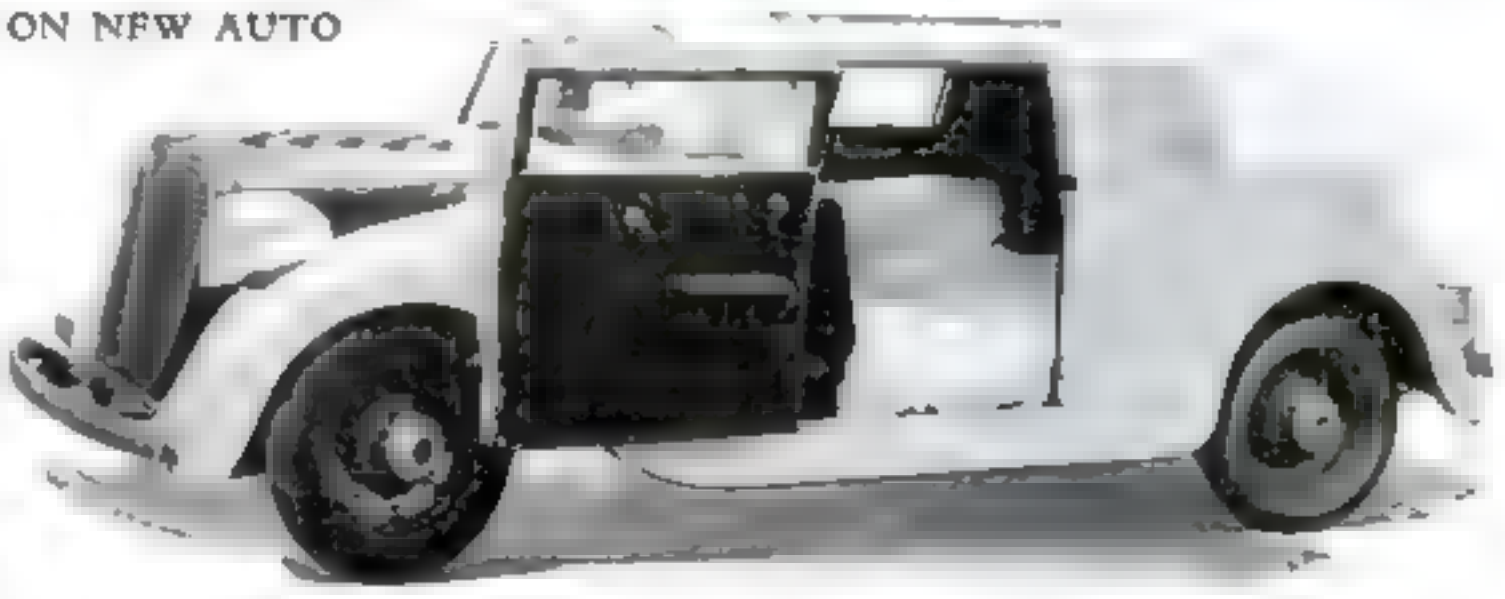
New Concrete Gets a Mirrorlike Surface as It Sets

[redacted]

CONCRETE, with a mirrorlike glazed surface is now being produced through a discovery made by a Burbank, Calif., inventor. The glazing is done as the concrete sets. According to the inventor, no new chemical has been injected, the secret of the process lying in the manner in which the product is mixed. Besides its use for decorative purposes and the replacing of glazed tile, the new construction material may find use in the building of aqueducts. By employing the glassy-surfaced concrete for lining the pipes, friction could be reduced and more water delivered in the same length of time, the inventor points out, thus permitting smaller-sized aqueducts to handle the same water supply and thereby considerably reduce the original cost of construction

NO FENDERS ON NEW AUTO

AN UNUSUAL automobile, now being manufactured in Colorado has a front axle that arches completely over the engine while the body extends the whole width of the fenders so that separate fenders outside the body are not necessary The width of the car makes it possible for an ordinary adult person to sleep crosswise in it. The drive is on the front wheels, and the design of body, as photo shows, is ultra-modernistic



This recently designed front-drive auto has an extended body, so wide an adult can sleep in it crosswise Note that extra fenders are not needed as body serves that purpose

First Air-Conditioned Auto

Through the grille seen above fresh air is admitted and old air is expelled in the first air-conditioned car seen at night

Beneath the floor inside the rear compartment is placed the refrigerating compressor to chill the air drawn into the car and make driving comfortable on hot days

With all windows sealed, and a stream of fresh, filtered air at just the right temperature entering through a special duct, the world's first air-conditioned automobile recently made its debut in a successful test run on New York City streets. It demonstrated a remarkable new system that promises all-the-year-round driving comfort, regardless of summer heat or winter cold. Air is drawn into this system through a concealed inlet, filtered to remove dirt and dust, blown over coils that chill or warm it as required, and admitted through grills to the car's interior. Cooling is effected by a refrigerating compressor beneath the floor boards, resembling that of an electric refrigerator which takes its power from the car's generator or may be run from a special battery. To heat the air, hot water is circulated through the coils from the car's radiator. The air-conditioning equipment may be turned on or off at will from the instrument board or rear seat. Since the windows of the car are kept closed, outside noise is excluded. Any closed car, new or old, may have the air-conditioning system installed, according to the New York concern sponsoring the invention, which expects to manufacture it in the near future at a sufficiently moderate cost to permit its use even in low-priced cars. The makers foresee the car of the future provided with air conditioning as standard equipment. In that event many of the inconveniences encountered at present will be removed, along with a decrease in the danger of suffering carbon-monoxide poisoning.

HOT-AIR APPARATUS DRIES PLASTER

Hot air and gas forced into buildings to dry plastered walls

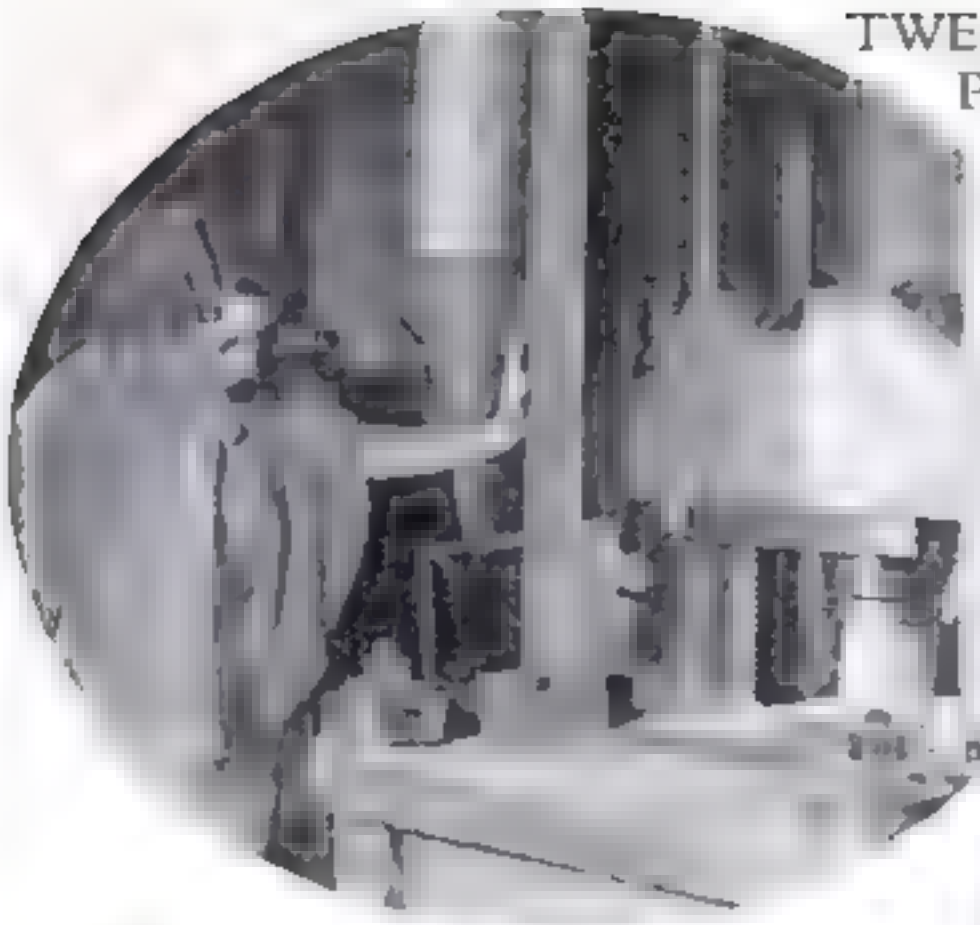
By forcing heated air and gases under pressure into new buildings, a Hamburg, Germany, contractor has cut down the time required for drying the masonry and plaster. Large apartment houses have been dried out in this manner in from two to four days—only a fraction of the time formerly required. To facilitate the setting of the plaster as it dries, special gases are carried into the buildings with the air. The doors and windows are kept tightly closed during the artificial drying process and the temperature of the air is regulated according to the type of building and the degree to which the interior has been finished. The range of temperature possible is from twenty to 200 degrees Centigrade.

Illustrations show how a new fountain pen is filled by pushing it down in a holding socket of inkwell

GRAVITY FILLS THIS NEW PEN

Provided with a capacious inkwell as a base, a new desk set will not run dry of ink at inconvenient moments. The special fountain pen is screwed into a threaded socket when not in use. If the pen needs re-filling, it is simply pushed downward in its sliding socket. Ink runs into the pen by gravity, the air in the barrel escaping through a valve opened by a small button at the top.

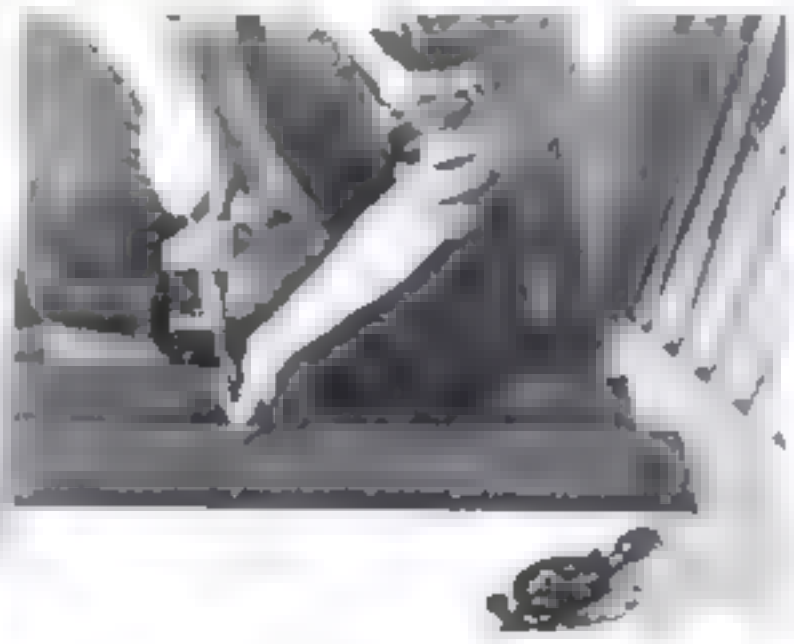
TWENTY YEAR OLD ROAD RESISTS PRESSURE OF 70,000 POUNDS



LITTLE larger than a tin can, a core of cement-bound macadam, taken from a twenty-one-year-old road at Selma, Ala., recently withstood a vertical pressure of 70,000 pounds in a Chicago testing laboratory. When the material gave way, it split in neat vertical cracks that ran uniformly through the stones and the cement which held them together. Originated in Scotland, this type of road is said to be particularly economical, the Selma highway having cost less than a dollar a year for upkeep. After twenty-one years this road of combination cement and broken stone, is still in good condition. Other communities have recently become interested in the combination pavements and are laying it wherever possible. Manufacturers claim that the new cement is more durable than that of twenty years ago.

NON-SKID TREADS FOR THE STAIRS

Children are unlikely to slip on the abrasive strip treads seen below. Right, putting down treads



SAFETY treads, of the non-slip, abrasive type long employed to prevent accidents in factories, are now available for use on home stairs. Grains of abrasive material molded into a base of semi-hard rubber give a sure footing and lessen the danger that children and others may slip and fall on the stairs. Unaffected by water or weather, the treads may be installed on interior or outdoor steps. They may be attached to wood, steel, concrete or stone by anyone who can handle a screwdriver and a drill. The treads are flat and will not catch shoe heels.

Light flashing on top of post above warns the fisherman he has a bite. Closeup at right gives view of the flexible strip that is pulled down by tugging fish to close an electric contact. Battery in handle furnishes power for light

FENDER LIGHTS WARN OF LEFT OR RIGHT TURN

TO MAKE it easy for a driver to signal his intention of turning, a new warning device is controlled from buttons mounted beneath the steering wheel and within convenient reach of the fingertips. Pressing the left-hand button illuminates arrows pointing to the left on front and rear fenders of that side. The right-hand button lights up arrows on the right fenders pointing in the opposite direction.

BITING FISH FLASHES AN ELECTRIC SIGNAL

WHEN a fish bites, an electric light flashes to announce the fact, in a new mechanical watchman for fish lines used at night. It enables a fisherman to be on the spot in time to land a catch, even when he has as many as three lines out. The body of the device, a pointed wooden stake, is driven into the ground. A line is tied to the base and then wrapped several times around a strip of spring metal at the top. A tug on the line pulls the spring strip against a set screw, closing an electric contact and lighting a flashlight bulb. The hollow stake contains a small battery.

Hobbies of Great Surgeons

AID IN LIFE-SAVING MARVELS

Workshops, Music, Art, And Sports Keep Nerves Keen and Fingers Nimble

By **Frederic Damrau, M.D.**

IN A recent series of articles in POPULAR SCIENCE MONTHLY, I told of the marvels of modern surgery and described some of the miracles of the operating room. Since then, scores of readers have written me, asking for facts about famous surgeons and how they fit themselves for their life-work.

How do they get into surgery? How do they keep fit for the nerve strain of the operating room? How do they develop their amazing, life-saving skill? These are the most common questions.

To find out, I talked with famous eastern surgeons and corresponded with others in all parts of the country. The result is a collection of fascinating, human-interest facts about men whose names are synonymous with surgical skil.

Consider, for example, the start of the famous New York plastic surgeon, Dr. H. Lyons Hunt. When he was six years old, he told me, he used to fill his mother's shopping bag with knives from the kitchen and make the rounds of the neighbors on his velocipede. At each house, he would ring the doorbell and gravely announce: "Dr. Hunt is ready to operate."

Before he was out of grade school, he was performing real operations—on frogs. When he found that the abdominal organs were covered with membrane, he thought he had made an original scientific discovery. He entered medical school at fourteen and was graduated at nineteen.

From the beginning, his one absorbing interest was the human face. He read every book on physiognomy he could find. He spent hours at the art galleries studying sculptured heads. He concentrated upon mastering the complex network of muscles in the face and neck, a network which comprises one fourth of all the muscles in the body. He practiced molding faces in plaster and clay. Today he molds them in living flesh as one of the world's greatest plastic surgeons.

Before every operation, he goes over an unretouched, lifesize photograph of the patient. On it, he makes notes, diagrams, measurements. He visualizes every step in the operation and its effect upon the future appearance of the patient. By scientifically working out every detail, he achieves his brilliant results.

I know another surgeon, a famous eye specialist, who, as a boy, was fascinated by eyes just as Dr. Hunt was fascinated by faces. He told me once that he used to make regular trips to the local butcher shop to get pigs' eyes which the butcher saved for him. He would carry them home and spend hours studying and dissecting them. Even today, before a particularly difficult operation he will practice it on a pig's eye, which is remarkably like the eye of a human.

Another New York surgeon, Dr. Arthur Stein, recalls a kind-hearted lady who visited his parents when he was eight years old. She asked him:

"Arthur, what are you going to be when you become a man?"

"A doctor," was his prompt reply.

"But why?"

"Because I want to drive a horse and buggy."

Today he is a doctor and a famous surgeon besides. But he doesn't own a horse and buggy. Instead, he rides around in a limousine driven by a chauffeur. By the time he achieved his ambition, horses and buggies were out of date and the automobile had come to stay.

For a doctor doesn't graduate from medical college and begin practicing surgery at once. He doesn't become an expert over night. He must first spend a number of years in general practice. Then he has to devote two or three years to intensive study of surgical technique under a recognized master.

One man, who has since become a noted surgeon, conducted a humble practice on the East Side in New York City for twelve years before he ventured to use a knife on anything more serious than a boil. Then he spent two years at various surgical clinics, assisting at operations and studying the methods of the masters. He came back a full-fledged surgeon and I have seen him perform amazing feats in the operating room.

The recognized surgeon cannot be a young man. It takes him too many years to prepare for his work. In fact the American College of Surgeons will confer its degree only upon doctors who have been in practice for eight years or more.

On the other hand, the life of the surgeon is notoriously short. The strain of operating daily under great nervous tension is so wearing that many surgeons have died of heart disease in their fifties. Recently, Dr. William J. Mayo lamented the fact that so many of his professional friends had died before reaching sixty.

Only a few weeks ago, I had occasion to note the terrific strain under which a surgeon sometimes works. I had been invited to watch one of my colleagues perform a difficult brain operation. The patient was an important business man. There was grave doubt as to whether he would recover.

Throughout the operation, the surgeon was outwardly calm. There were several minor mishaps that could not be avoided, but he did not lose his temper. I knew he was a man of iron nerve and tremendous self-control because I had played golf with him and had never seen his even disposition disturbed.

But when the strain was over he was almost in a state of collapse. He trembled as if he had been through the third degree. I had to hold his glass for him while he drank ice water and later he asked me to drive him home because he was afraid to handle his own car.

People who think that surgeons are cold-blooded creatures, unaware that human life depends upon their skill, are mistaken. It is their keen realization that a single slip of the knife may mean death to the patient that adds to the tension. Again there are sudden emergencies for which the surgeon must be prepared.

A dramatic instance of this kind occurred recently in France. Bleeding internally and near the point of death, a woman was brought to the Rothschild Hospital in Paris. Only an immediate blood transfusion would save her life. When all those present were tested, it was found that only the blood of the chief surgeon matched the patient's and could be used. Without hesitation, the doctor drained blood from his own veins for the transfusion. Then he operated upon the patient and saved her life!

To be prepared for such emergencies as well as for the constant strain of the operating room, surgeons train like athletes to keep physically fit. They regulate their diet and their hours of sleep. A majority of them are total abstainers from alcohol. Many avoid the use of tobacco entirely. Some do not even touch coffee or tea. And all are particularly careful to obtain a good night's sleep.

"A tired surgeon is a poor risk for any patient."

That is an epigram of the New York specialist, Dr. Abraham Wolbarst. He makes it a point to spend the evening before a heavy day in the operating room reading light fiction or a detective story to relax his mind. Dr. H. W. E. Walther noted New Orleans surgeon, obtains the same result by going over his collection of Japanese swords and prints. Dr. Morris Levine, who has achieved results bordering upon the miraculous in his treatment of "hopeless" mastoid cases, lies on a couch and prays for divine assistance before every operation. Dr. H. Lyons Hunt closes himself in his room and takes a refreshing nap of five or ten minutes before he begins his work.

But the most curious preparation of all is made by another New York specialist. He always spends the evening before an operation at the movies. But he doesn't go to see the show. He sits in the theater where he will be quiet and undisturbed, and goes over in his mind each step of the operation.

During the World War, I was fortunate enough to serve in the Medical Corps of the Army under Dr. K. Winfield Ney, one of the great brain surgeons. Only a few months ago, Dr. Ney demonstrated a remarkable new operation for the cure of epilepsy. (P S M, May '33, p. 24.)

A direct descendant of Napoleon's great general, Marshal Ney, he was left an orphan at the age of nine and educated himself, working his way through college. He has iron control of himself and has disciplined his nerves to stand terrific strains. During the hectic days when the American divisions were making their famous drives at Chateau-Thierry and in the Argonne, Dr. Ney spent sixteen out of the twenty-four hours in the operating room and often performed as many as thirty or forty operations a day! And one brain operation takes more out of a surgeon than a number of abdominal ones.

To keep fit, he regulates his life like clockwork. He rises at eight and is never known to be late at the hospital. His morning is spent in operating; his afternoon in seeing patients and studying their conditions. Then he takes an hour's nap before dinner. The evening is passed in playing chess, bridge, or seeing a serious play. Four hours, from eleven at night to three in the morning, are devoted to reading and writing scientific literature. He has found that he is at his best on six hours' sleep, five at night, from three to eight, and one hour during the day. More sleep impairs his concentration.

HOW [illegible] GAINS SKILL. A [illegible] and which he talks while he is operating. His description is taken down by a stenographer who is shown at left. Picture at top shows an operation in progress which is being described by the surgeon for the benefit of the interns who are seated behind a glass partition and who by means of a loudspeaker hear what is said

[illegible]

BIG HELP TO [illegible]

Ingenious mechanical aids are used in teaching the technique of delicate operations to student surgeons. As the picture shows a movie camera is used to record the various steps in an operation on the throat

DEADLY GERMS BEATEN BY ETERNAL VIGILANCE

Doing fine work with his hands is second nature to Dr Ney, his mother having been an artist and his father an inventor When he was twenty he was an expert on gems. Handling precious stones and designing their mountings helped to develop in his fingers the fine mechanical sense required for delicate operations.

Because it demands a coordination of rapid movements, Dr Ney practices trap shooting during much of his spare time Also he trains his fingers for hours at a time by modeling clay carving wood, and practicing sculpture. In addition, he finds relaxation in working with woods and tools in his home workshop.

But like all surgeons, he is particularly careful, in doing such work, not to injure his hands and fingers. Every cut or blister is a possible source of infection and must be guarded against One of the prime features of a surgeon's program of keeping fit is the care of the hands.

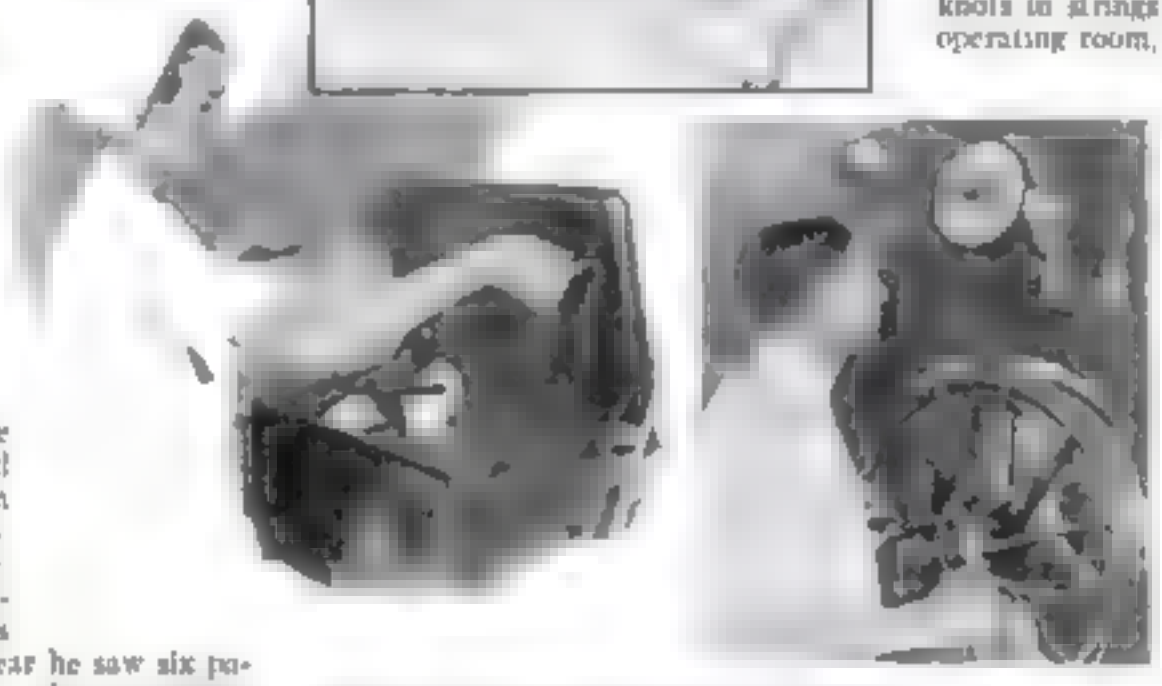
To keep the balls of his fingers pliable and sensitive, one noted surgeon in the middle west tells me he always wears leather gloves when he goes fishing. Another was forced to give up baseball because the sport was hardening his hands. Hangnails are particularly dreaded and special care is taken in manicuring the fingers Dr Hunt, for instance since 1902, has never allowed anyone to cut his nails for him. In that year he saw six patients die from infection when a surgeon friend of his developed a hangnail after a manicure. Pus gathered under the broken skin without his knowledge and only after the patients had died did he discover the source of the infection

In winter most surgeons wear fur-lined gloves and take special precautions against chapped hands They rub glycerin or imported coconut oil into the skin every night, In addition, they are careful of the soap they use, choosing only bland varieties which do not contain harsh ingredients.

The "scrubbing up," which is part of the preparation for every operation, is particularly hard on the hands. As a first step in sterilizing his hands, to prevent the danger of contaminating the open wound the surgeon washes with soft soap in a stream of running hot water Using sterilized gauze pads and hand brushes, he goes over his fingers again and again Then, he trims his nails short and carefully smooths them down. Finally, he immerses both hands in a strong solution of alcohol for two minutes.

After all these preparations are completed, the hands are dried with a sterile towel, powdered, and slipped into sterilized rubber gloves. Thus even if a glove tears during an operation, the surgeon's hand will carry no germs of infection into the wound

It can be easily understood how such a process of "scrubbing up" carried on day after day, results in irritation to the skin. One famous New York specialist has had to quit operating for weeks and months at a time because of hypersensitive skin. But in spite of this handicap, he has attained national recognition by his work.



Even greater care is exercised by the surgeon to keep his hands free of germs than is taken with the instruments and bandages he uses in the operating room If a hands are not only scrubbed and then washed in alcohol, but he manicures his nails with great care and then wears rubber gloves The top picture shows a surgeon sewing up a wound while the other two views show an operator right controlling the steam for the sterilizing chamber and a nurse left carefully removing the sterilized instruments

Frequently, surgeons must fight some handicap that lies in their way One of my surgeon friends, for example, is nearsighted. Another is lefthanded. Another, a noted eye specialist, had to battle against a trembling of the hand due to nervous tension during operations. He took up golf and credits it with having given him the poise and self-control he needed for his professional work

Curiously enough, what would appear to be the worst handicap in the world for a surgeon has actually been an aid to the career of another eastern specialist. Imagine a surgeon fainting at the sight of blood! That is what this doctor did repeatedly during his freshman year at medical school. He still has a horror of hemorrhage However this very fact has led him to devise special methods to control bleeding. As a result, his operations are practically bloodless and the conserving of the patients' life-stream in this way contributes largely to their rapid recovery

Almost all surgeons are constantly seeking to increase the skill of their hands and their ability to coordinate brain and muscle. One surgeon of my acquaintance took up etching as an aid to developing more delicate control over his fingers, Several whom I know learned to play the violin in order to increase the nimbleness of their hands. Again, Dr Forbes Hawkes, noted for his remarkable operations upon the kidney, learned to play the piano as training for his fingers although he did not care for it as a musical instrument

In fact, so far as the hands are concerned, there are many points in common between the pianist and the surgeon. The active hands of a Paderewski would have no difficulty in tying a row of stitches rapidly and unerringly

To perfect himself in this phase of his work, one Brooklyn, N Y., surgeon reports he spends part of each evening tying knots in strings around a bedpost In the operating room, he is noted for the speed with which he ties stitches in closing a wound.

Fencing is the method used by another surgeon to keep his eyes and muscles in perfect coordination. In addition, he plays musical instruments that require the use of both hands. For, whereas the average craftsman is skilful with either his right or his left hand, the surgeon must have a high degree of dexterity in both hands. In fact most of the masters of the operating room are ambidexterous, equally at home when using either hand. I have seen famous surgeons working first with one hand and then with the other, according to which one gave them the best conditions for cutting or sewing during an operation

Performing operations upon animals for scientific research, is another method by which the surgeon trains his hands to perform delicate tasks. In this work the experimenter is often dealing with tiny glands and the slightest slip upsets the whole experiment. It is interesting to note that it was through such an experiment that Dr. Frederick Banting, of Toronto, Canada, discovered insulin the gland extract which has aided thousands of sufferers from diabetes. This discovery by the Canadian experimenter is rated as one of the greatest made in the field of medicine

Dr Harry Koster noted Brooklyn N Y., surgeon, is another who carries on experimental work on animals almost continually. He finds it the best preparation he can make for delicate operations upon suffering patients in the hospital

In recent years, the life-saving record of surgery has been climbing steadily More than a million operations a year are performed in the United States alone And the loss of life is notably small Much of the credit for this remarkable record must go to the infinite pains with which the surgeon prepares for his work and the unceasing efforts with which he seeks to increase his skill and technique

Here are a few of the 20,000 buffalo that now constitute big government protected herds in the northwestern part of Canada. Originally started with only 700 animals their increase has been amazingly rapid and now each year about 1,000 of them are killed for fur and food and buffalo robes are again becoming extremely popular

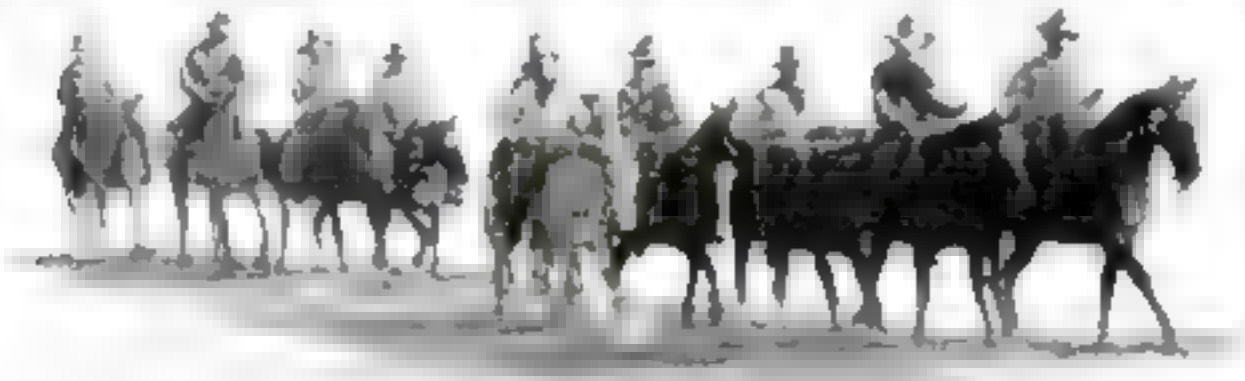
CAN THE Buffalo COME BACK?

BUFFALO steaks for western restaurants, buffalo coats for northern travellers, and a buffalo round-up for tourists, attest to the fact that the once nearly extinct buffalo is making a come-back. According to recent figures of the Canadian government, there are now nearly 20,000 buffalo on vast preserves. Twenty-five years ago the Canadian government purchased about 700 animals, constituting the last herd in existence.

Every year about 1,000 buffalo are killed by high-powered rifles on the Canadian government's preserves in western Canada. Their meat goes to stores and restaurants throughout the west, both in the United States and Canada, and buffalo steaks are also procurable in the larger cities of the East. Buffalo coats are being used for the winter outfits of the Royal Canadian Mounted Police.

The main herd, over 6,000 animals, is kept at Buffalo National Park, near Wainwright, Alberta. Here an annual round-up is held each autumn, the only buffalo round-up in the world. The animals are driven by hard-riding cowboys to the corrals where the yearlings are branded.

At left, buffalo are being loaded for transportation from Wainwright to Wood Buffalo Park. Below, cowboys who ride the range and see that the buffalo is safe



Because the park at Wainwright will not provide grazing for so large a herd, every year sees more than 1,000 young buffaloes herded into corrals, pushed onto sloping ramps, and bundled into railway cars, which take them to Waterways, the end of the railway in northern Alberta. Here they are unloaded into corrals once more, then herded onto flat-bottomed barges, and towed for nearly 1,000 miles along the Athabasca and Slave Rivers to Wood Buffalo Park in the North West Territories. Here there is a herd of about 10,000 animals, enjoying a domain of 17,000 square miles and protected against the ruthless killing by poachers.

You can Photograph with your EQUATORIAL

This cut at left shows how your homemade telescope can be adapted with slight changes, to take pictures of the moon, such as the one at right, as seen in the finest

By
GAYLORD JOHNSON

HAVING made a star-trail photograph with your camera, as described in the first article of this series (P.S.M., Apr. '33, p. 38) I am sure you will want to take pictures of the moon, the Pleiades, and other star groups that are visible in our hemisphere.

The fascination of astronomical photography will grow upon you. To develop a film and find that you have obtained a beautiful image of the moon that can be enlarged up to three or four inches in diameter will give you a real thrill. You won't stop photographing the moon until you have made a series of six or more pictures showing our nearest neighbor in all her phases.

Then with only a slight change in your apparatus, you can easily make photographic maps of the principal stars. If you preserve your prints in an album, you can gradually build up an interesting star atlas. One by one, you can add maps of the Great Bear, of Orion, of Taurus, of Andromeda, and of the other constellations that annually move across the heavens in a majestic procession.

In this article I shall show you how to add to your equatorial mounting (P.S.M. Oct., '33, p. 36) the simple mechanism that will enable you to follow the stars during the prolonged exposure needed to take a picture of them. This slow-motion device, however, is not needed to obtain a fine picture of the moon. This can be done in half a second, during which time the movement of the moon's image on the film will be too small to spoil the sharpness of the picture.

The only additions needed for turning your homemade equatorial telescope into one for moon photography are a simple camera made of cardboard and a finder tube for getting the position of the moon's image after the film has been put in place.

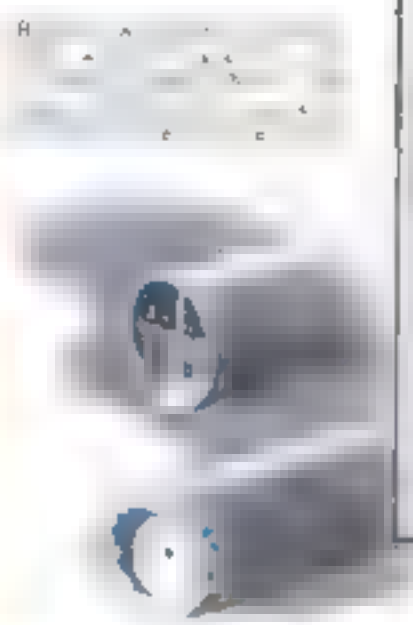
I am taking it for granted that you have built your telescope either with a [illegible] portrait [illegible] achromatic lens for an [illegible] glass, or with a weak positive or convex spectacle lens of about six feet focus. The latter is known to opticians as a "half-diopter" lens.

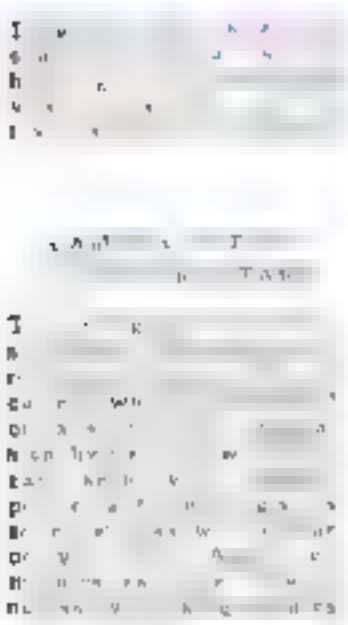
If you have used a portrait attachment lens of about three feet focus, you can expect it to throw an image of the moon about one centimeter or two-fifths of an inch in diameter. The six-foot spectacle lens, however, will give a three-fourths-inch moon image that will be much more satisfactory for subsequent enlargement. Also the larger image will be sharper, as the errors of the longer focus spectacle lens are less apparent. For astronomical photography, I strongly recommend the use of the spectacle lens and a six-foot telescope tube. It will be easy for you to extend a shorter telescope by adding the required amount of cardboard mailing tube and rebalancing your telescope on its equatorial mounting.

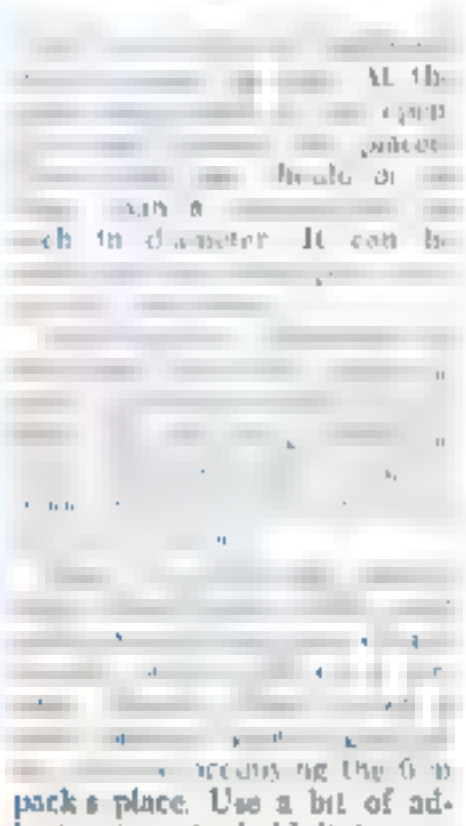
Simple Changes Convert Your Homemade Instrument into a Camera with Which to Take Photos of Heavenly Bodies . . . Slow-Motion Device that "Stops" the Stars

the Moon *and* Stars

TELESCOPE







To find the focal length of the spectacle lens, and the size of the moon image which it produces, hold the lens in your fingers in the sunshine and move it back and forth until the sun's image is sharp on a wall or piece of white cardboard. By a strange coincidence, the apparent size of the sun and moon are the same. Thus, by the way, is why total eclipses of the sun are possible. Accordingly, the diameter of the sun's image on the wall will give you the size of the moon's image on the film of your telescope camera.

After determining the approximate focus of your object glass, make the telescope tube three or four inches shorter so that the camera attached to the sliding eyepiece tube can be moved up until the image is in focus on the film.

Now you can proceed to build the camera.

Since you are going to photograph the moon with the object glass alone, you must remove the linen-counter eyepiece lens which you attached to the sliding eyepiece tube, and replace it by the camera. A better way, however, is to make another sliding tube to carry the camera, because this leaves your original eyepiece assembly intact for visual observations when you desire.

The camera is simply a shallow box built to hold a film pack of small size. The pack can be held in place by strong rubber bands.

A dark slide is necessary to prevent fogging the film when the eyepiece tube is removed from the telescope. This is essential when carrying the film to the dark room for development.

After the camera is built and glued to its sliding tube, the next step is to provide a finder tube to use in pointing the telescope when the camera is in position. This is merely a mailing tube about a foot long, attached to the telescope as shown in the illustration on the opposite page. At one end of the finder tube an eyelet is

pack's place. Use a bit of adhesive tape to hold it tempo-

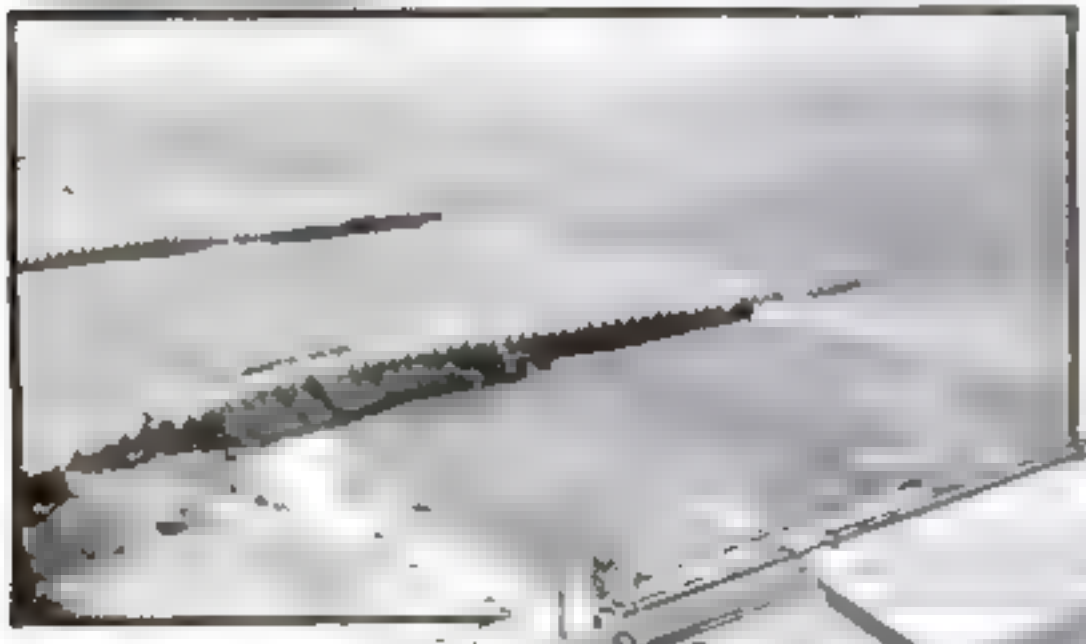
rarily. Adjust the telescope so that the image of the weathervane appears in the center of the ground glass. Slide the camera tube in or out until the image is as sharp as possible. Mark with a pencil the place on the camera tube where it enters the telescope tube. This establishes the focus of the camera for future use. Then, without moving the telescope adjust the finder tube, held temporarily upon its supporting blocks by rubber bands, so that the weathervane is exactly in the center of the cross threads as you look through the eyelet. When the adjustment is right, make it permanent by flowing some liquid glue between the blocks and the tubes, using a small camel's hair brush, and allow it to dry in position. Later, the finder tube can be wired still more firmly to the telescope tube.

You are now ready to find the photographic focus of your telescope camera. This will probably be slightly shorter than the visual focus *(Continued on page 104)*

MODELS POINT

Vanishing

In the steel channel, left, the rate of water flow was determined by pieces of paper and the erosion of sand on the bottom was noted to find what materials to use in the shore model. Below, view of California coast showing new beach between groins



TWO young scientists stood at the valves that controlled the ebb and flow of ocean tides in the small model before them. Almost hidden from public view on the shaded grounds of the California Institute of Technology the forty-foot model—containing two rivers, a large bay emptying into the Pacific ocean, and the channel through which tides flow—looks exactly as the real coast looks from an airplane flying over southern California.

With this model, it is hoped, several perplexing problems will be solved. Eventually the work may lead to the development of a system that will check the ocean in its attacks on the Atlantic and Pacific coasts, keep bay and harbor channels free from sediment and confine rivers to their channels, thus preventing the loss of hundreds of millions of dollars to those owning property on the shore.

For years it has been known that the oceans, in some sections, are eating at the shore line.

On the California coast from Point Arguello to Point Buchon the coast line, as the result of centuries of wave action, has assumed a jagged, sawtooth form. Here are found many indications that powerful waves are gradually eating away the headlands. Beaches are drifting southward while rock jetties, fashioned by human hands, preserve the shore.

In southern California the coast line consists of stretches of sandy beach alternating with rocky shore. Several years ago heavy storms and floods swept away a strip of land on which an expensive road had been built. Such recession of the shore line not only is being stopped now but new beaches are being formed by building out into the ocean thin fingers of concrete and sheet steel, known as groins. These break up the powerful, swirling action of the waves, which carry sand away from the shore.

During the last 100 years accurate measurements show that the New Jersey coast, along 134 miles of ocean front, has eroded on the average of two feet a

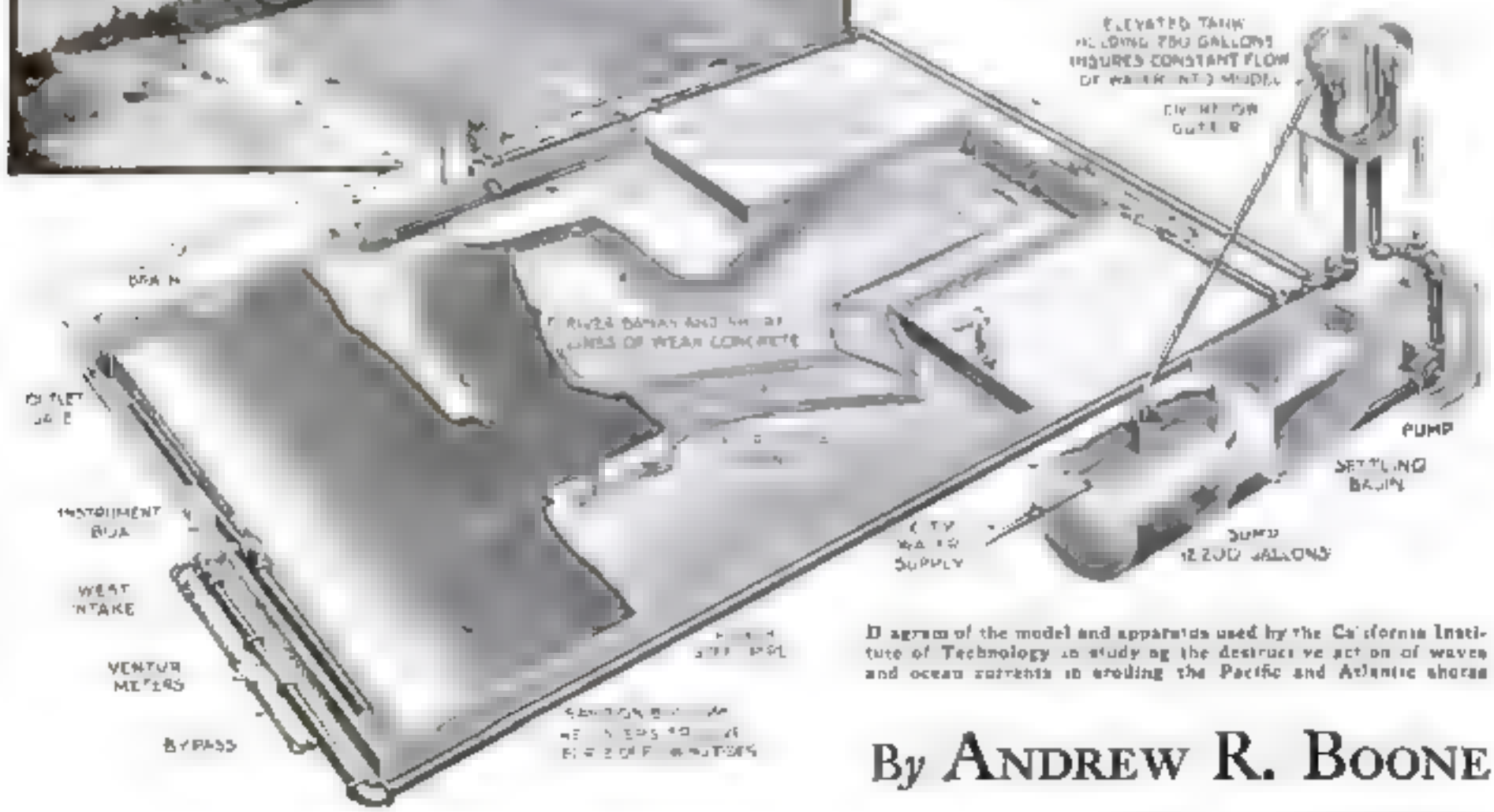


Diagram of the model and apparatus used by the California Institute of Technology in study ng the destructive act on of waves and ocean currents in eroding the Pacific and Atlantic shores

By ANDREW R. BOONE

WAY TO SAVE

Coastline

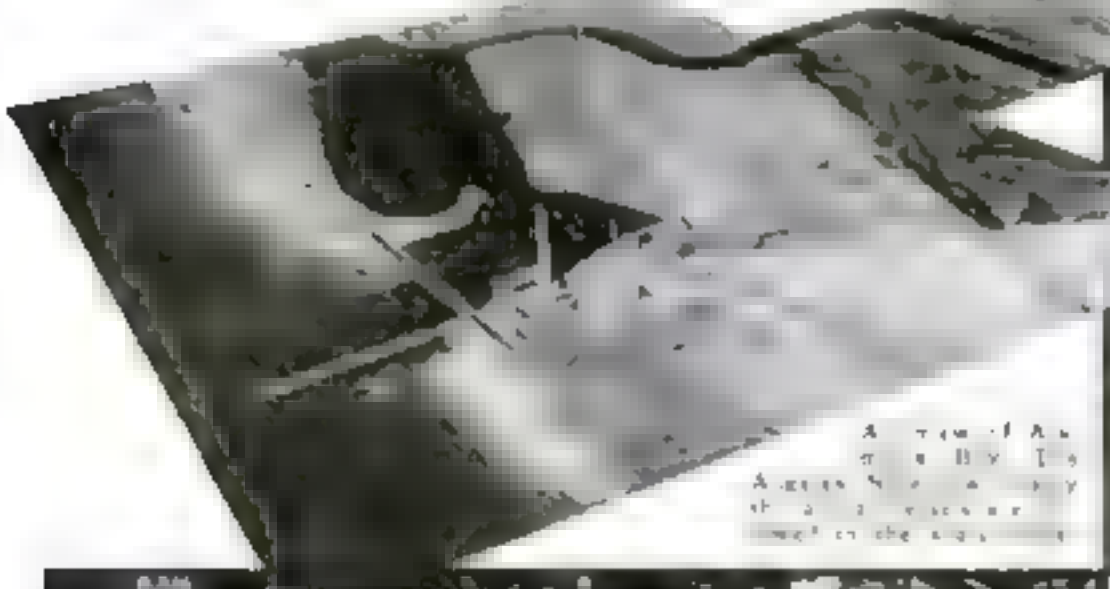
year. This record indicates an erosive tendency of forty miles in 100,000 years—a rapid rate when measured in geological time

Shore protection problems have become highly important in recent years, not alone because of the New Jersey and California experiences, but also because the public demands more and wider beaches. Fortunately science is finding a way, through the study of relatively tiny models, combined with experiments along the coasts and beneath the surface of the oceans themselves, to save the long coastlines against further serious inroads by the seas.

In my investigation for the readers of POPULAR SCIENCE MONTHLY, I found that many agencies constantly seek new light on the common problem. Of the several methods, perhaps the models are most important. Yet engineers, public and private, also are going down to sea with other interesting apparatus and methods.

Red sand is placed in a trench on the beach at Seaside Heights, N. J., that its movement along the beach may be studied. Giant sand particles, in the form of sixty weighted croquet balls, settle down in the Atlantic off the Jersey coast to supply data from which to compute the bottom forces. Observations of ocean currents by means of stationary meters are made. Currents generated by strong winds, tidal currents, effects of currents on sand movements, wave breaking or plunging of waves, and even the motion of water particles in waves are being observed and analyzed.

Many protective works in rivers and along the coasts have been



From a swinging crane vertical pictures are taken of the model to record the erosive action of artificial tides. At left, the scientists are studying the effect of tides and currents in the tiny model

built, but there has been no uniformity in the types of structure. A breakwater serves a useful purpose at one place, a small jetty or groin, projecting a short distance into the sea, but da up the beach at another But there are many other problems, which today are being carefully examined by the Beach Erosion Board of the U. S. Army

Not all these investigations are concerned with a recession of the shore line, however Along the New England and the Pacific coasts, rocky headlands reach down to the borders of the sea. Between such headlands bays are formed and at the heads of such bays pocket or bayhead beaches are frequently found. Often adjacent low lands may be subjected to destructive overflows either from high tides or floods from rivers emptying into these bays.

Except in isolated cases, *(Continued on page 142)*

Polish Woman Studies Early American Skulls

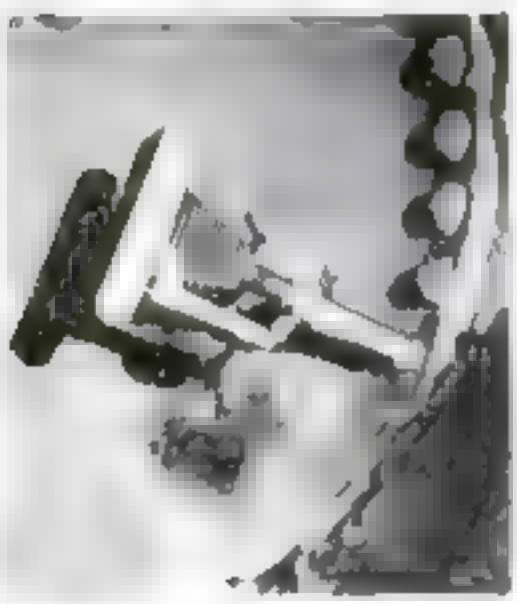
Dr. Hrdlicka and Dr. Pitrowska-Stolyhwo, of Poland, examining skulls

Skulls of American aborigines led recently to a 4,000-mile journey by the famous woman anthropologist of Poland, Dr. Eugenie Pitrowska-Stolyhwo. For some time, she has been making a study of the relationship between the early peoples of America and Asia. While in America she will spend much of her time working with the collection of prehistoric skulls gathered by Dr. Ales Hrdlicka, anthropologist of the Smithsonian Institution, at Washington, D. C.

ELECTRIC RAZOR-BLADE SHARPENER RUNS ITSELF

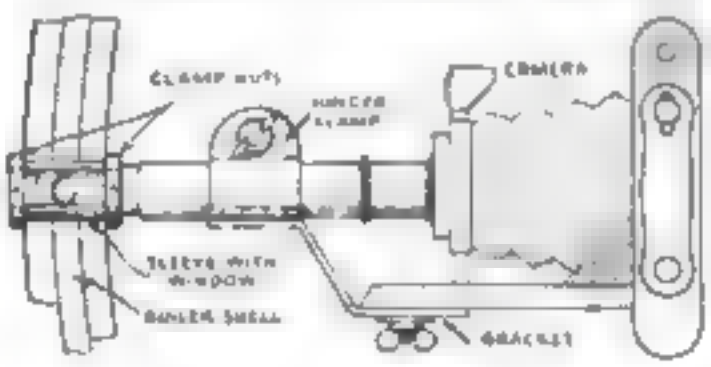
Complete in a compact box, a new razor-blade sharpener runs by electricity, automatically stopping when the blade is ready for use. Two upright pins in the box hold the blade in place. The lid is closed and, according to the manufacturer, the device does the rest. Whirling rollers strop the blade until it is perfectly sharp and then the current is automatically cut off.

CAMERA PERISCOPE INSPECTS BOILERS



Above, camera periscope being used to search for obscure flaws in a steam boiler. At right, diagram showing how the camera photographs inner bores

Magnified pictures of hidden cracks in steam boilers are being taken by a Hartford (Conn.) insurance firm with a new camera periscope to present owners with convincing evidence of defective equipment. Applied to rivet-hole walls, the device reveals fissures otherwise visible only to an inspector's expert eye. In one Texas plant it recently disclosed a boiler so weakened as to be in imminent danger of exploding, and the boiler was replaced in time to avert a serious accident which might have occurred had not the defect been discovered.



VEST-POCKET SLIDE RULE

A midget slide rule that slips in a vest pocket and costs less than one-tenth that of the ordinary rule has been introduced by a Connecticut manufacturer. The rule is equipped with a metal back in place of the usual wooden one, thus preventing the warping that formerly was possible.

SEAPLANE RACES WITH BRITISH SPEEDBOAT

Rot srisc a turn neck and neck, a racing speedboat and a seaplane were caught in this remarkable action picture by a British photographer. The light monoplane acted as pacemaker for the boat during practice runs in preparation for a regatta. The lower wing of the plane, as it banked into some of the turns, fairly skimmed the water. By its brushes with the speedboat, the little monoplane, equipped with a single pontoon, gave added interest to the trial runs.

Ship's Gage Shows Speed and Distance Run

Showing the speed in knots and the total distance covered on a voyage, a new speedometer for ships has passed final tests and is being adopted by transatlantic and naval vessels. Perfected by an American marine inventor Edward S. Cole, the device is known as a pitometer

A streamlined bronze rod extends for approximately two feet below the keel of the vessel on which the speedometer is installed. Near its end are two tiny holes, one in front and one on the side. They are the entrances to small tubes which run up the center of the bronze rod and connect with a U-shaped, mercury-filled manometer, or pressure gage, in the hold of the vessel

When the ship is plowing ahead through the water the pressure on the front hole is naturally greater than on the one at the side. Variation in these pressures cause the mercury in the manometer to rise or fall. A float is thus moved up or down, actuating the speedometer mechanism and producing the readings on the dial of the master instrument. Through an electric circuit, duplicate readings are shown on other dials distributed at various points about the deck

When desired, the bronze rod can be drawn up into the vessel. The manometer is so mounted that rolling and pitching in heavy seas does not affect it. The American liner *Washington* is one of the ships equipped with the speedometer and it is expected that others will soon install it as its dependability and accuracy become more widely recognized.

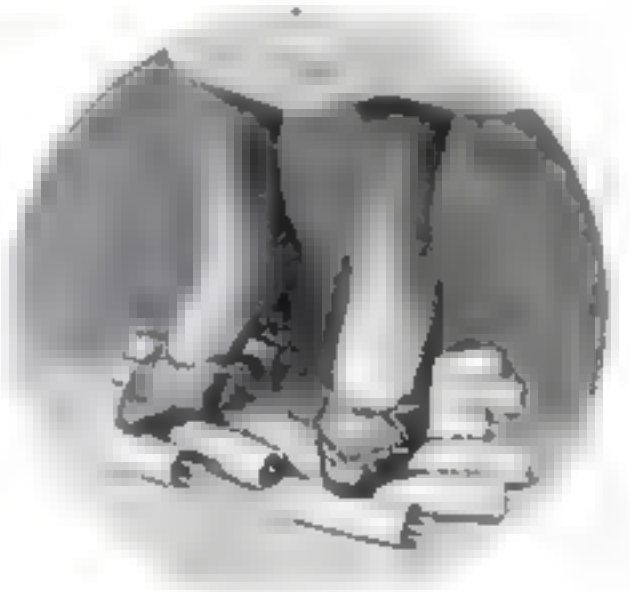
At upper left, shows speedometer with dial showing knots and figures below giving the distance run. Above, mercury manometer beneath the speedometer so suspended that it always stays centered. At left, rod that is also held to ship's bottom. Note pressure hole

PHONE NUMBERS ON ROLLS IN INSTRUMENT'S BASE

Four alphabetical number files are mounted within a compact telephone base recently produced by an eastern inventor. The frequently desired numbers are written on cloth sheets attached to spring rollers within the base. The sheets are pulled out as shown above and snap back in place when released. The four sheets hold 180 names. Swivel mounting of the base facilitates access to any one of the lists. In the base, also, are paper and pencil.

WATER CHANGES BLACK CRAYONS TO PAINTS

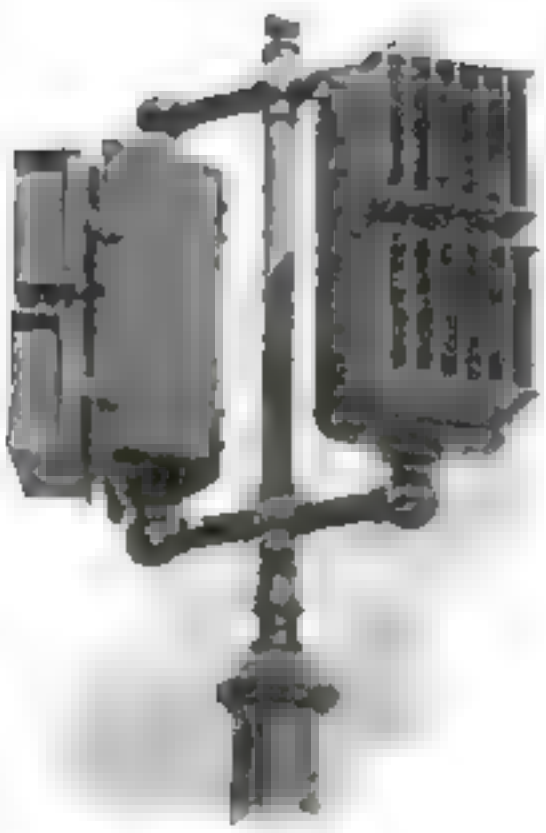
Contrasting crayons and water colors, a new outfit for children has been introduced into this country from England. All of the crayons leave black lines when they are used to trace the outlines of pictures. But, when a brush, wet with clear water is drawn over the crayon lines, they turn into water-color paint producing the color indicated by the label. They are then spread like ordinary paints.



Drawing set of black crayons that turn to water colors if dampened with a brush

RADIO TUBE OF METAL CAN BE WALKED ON

Proof against the roughest handling, an indestructible type of radio tube developed in England is so sturdy that it may even be stepped on without damage, as shown above. A metal bulb replaces the customary one of glass, maintaining the vacuum and also serving as the anode, glass is used in the tube only to insulate the bulb from the metal base. The tube is encircled by a metal cylinder for electrical shielding. It is designed for use anywhere but should prove especially valuable in portable sets or others frequently moved.



BLINDERS ON TRAFFIC LIGHTS AID DRIVERS

SQUARE traffic lights equipped with blinders are the latest apparatus for street-corner control being tried out in New York City. Light vertical partitions in front of each light protect the colored glass from the glare of the sun, which frequently confuses motorists in the old style of open lights. In addition, the darkened housing is said to give a more brilliant and easily seen signal when the traffic lights are on. The projecting fins also prevent drivers from seeing the cross-traffic signals and thus discourage attempts to beat the lights

Tubes Bent Without Kinks

METAL tubes are bent without cracking or distorting their walls by the use of an alloy that melts at a low temperature. The alloy, which consists of bismuth, lead, tin, and cadmium, melts at 160 degrees, Fahrenheit. To use it, the alloy is melted under water and then the water and metal are poured into the tube to be bent which is held vertically with its lower end plugged with cork. The water heats the tube before the alloy reaches it and thus prevents cold sets. Naturally the water is forced out by the heavier metal. Cold water is then run around the tube to chill the alloy quickly. When cooled to room temperature, the alloy-filled tube can be bent at will into a variety of shapes, as shown in the photograph below, without developing kinks. The alloy is easily removed by immersing the tube in boiling water which melts the soft metal so it will readily run out. The manufacturer says the alloy does not pit the inside of the tube and can be used repeatedly without loss of volume and thus it proves a most economical process.

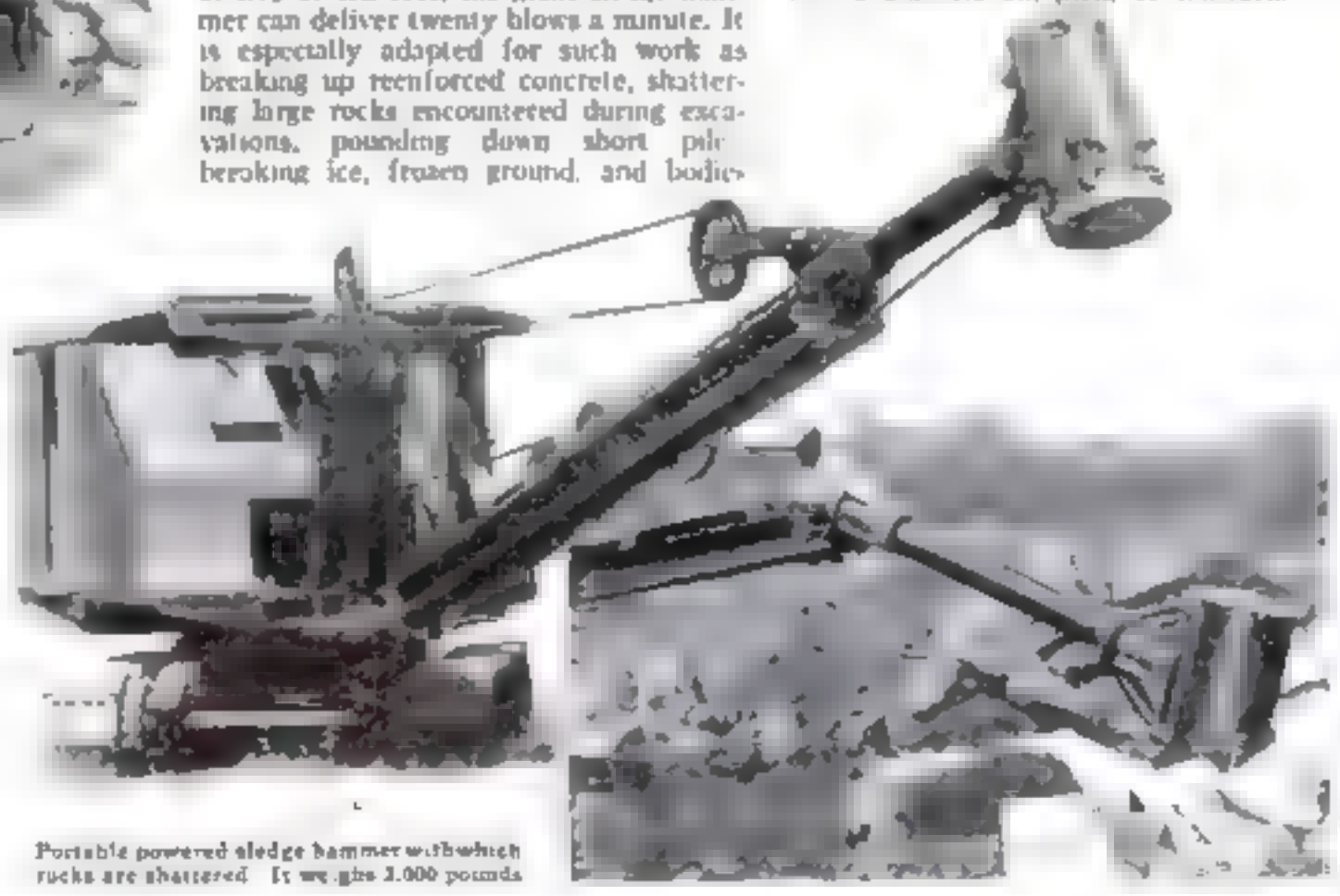
Tubing is bent without kinks by melting an alloy, right, and pouring it into the tube. It can then be bent into many shapes as shown below. At left, heating the bent tube to remove the molding alloy

FOOD PACKED IN BEER STEIN

ADDING a handle to the container in which prepared food is packed, the manufacturers have turned the glass jar into a stein. When the metal lid that protects the contents is removed, it is found that the lip of the jar is smooth, there being neither threads nor shoulder to interfere with its use as a stein, which it closely resembles in shape and size. When purchased the stein is hermetically sealed

PORTABLE HAMMER BREAKS ROCKS

A HAMMER that weighs a ton and a half and is capable of shattering granite boulders or demolishing small structures has been mounted on a power shovel to produce a new mechanical aid for construction gangs. Dropping from a height of five or ten feet, the giant sledge hammer can deliver twenty blows a minute. It is especially adapted for such work as breaking up reenforced concrete, shattering large rocks encountered during excavations, pounding down short pile breaking ice, frozen ground, and bodies of shale and sandstone which are too hard to dig with the ordinary power shovel. Because the striking face of the hammer is removable, other shapes can be substituted as the work demands. Thus, for special uses the hammer can be turned into a gigantic ax, pick, or mattock.



Portable powered sledge hammer with which rocks are shattered. It weighs 3,000 pounds

AIRPORT'S CIRCLE HELPS PILOT CHECK COMPASS

On the airport at Portland, Ore., is a huge white circle that enables transport pilots to check their compasses with a minimum of effort. Lines divide the circle like a cut pie. By using a plumb line, the ship is jockeyed into a position facing directly along one of these lines, and the compass reading is taken. If the compass is set correctly, it gives the same reading as that represented by the line on the ground. If it is off a few degrees, the pilot can either set it right or allow for the error in charting his course. Readings are taken on all the lines as a complete check on the instrument in the airplane.

Large circle with radiating lines, laid out on the ground at Portland, Ore., airport, is used by pilots to test the accuracy of their compasses.

DEVICE AUTOMATICALLY TESTS OIL IN MOTOR

Having the appearance of a large hypodermic needle, a device recently placed upon the market is said to test a car's motor oil and automatically record its cleanliness. The needle-like tube at the end is inserted into the crank case through the bayonet-gage hole, the breather hole of the filler, and the plunger at the top is pushed down several times and then allowed to rise as far as it will go. After the instrument has been removed, the gage is made. "Clean" and "Dirty" are stamped on the plunger with a calibration mark separating the two words. If the plunger rises until it exposes the "clean" mark the oil is safe to use; if it does not the oil should be changed. The amount of dirt in the oil determines how far the plunger can rise. The test should be made the maker states, after the engine has been running.

With this syringe like device oil is drawn from a motor and its condition automatically found.

New English car that is only 27 inches in height.

LOWEST AUTO ONLY 27 INCHES HIGH

With an overall height of only twenty-seven inches, a dachshund car recently appeared on the roads of England. It is believed to be the lowest automobile in the world, the distance from the top of the windshield to the pavement being less than three times the height of this page. It was built by a Bradford engineer.

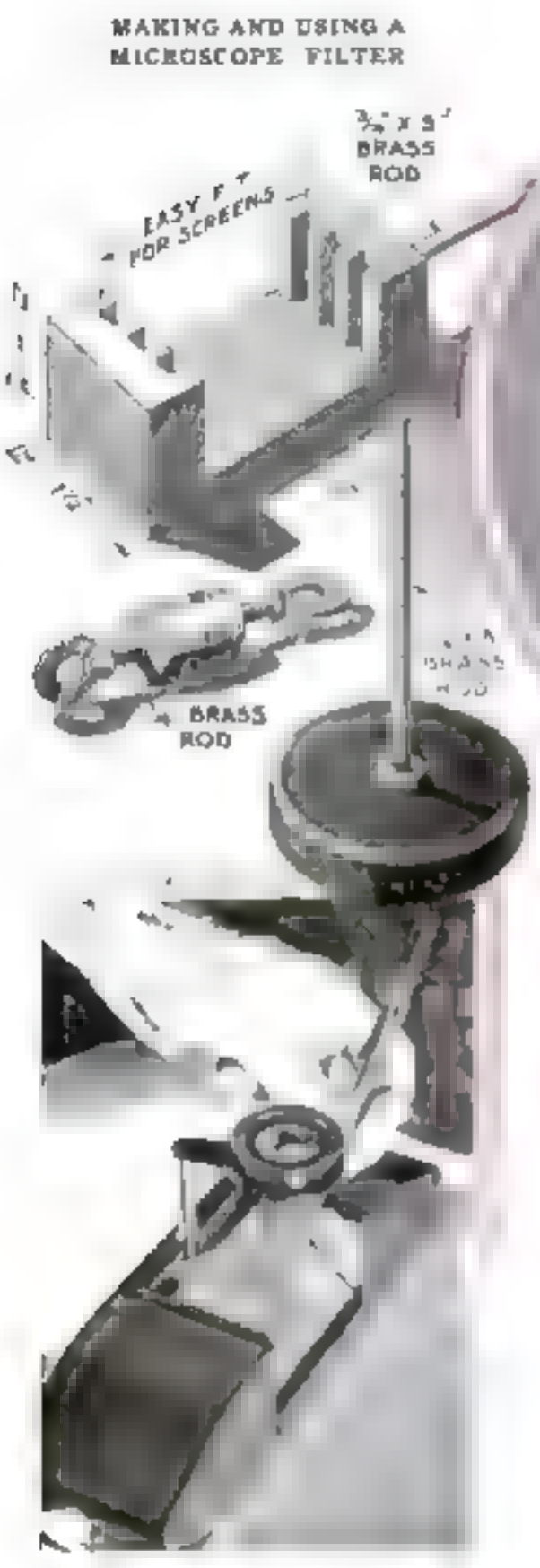
USE MAGNETIC NOTES TO TEACH MUSIC

Musical notes, held in place by magnetism, are used in teaching children the rudiments of music.

Magnetic notes for teaching children the elements of music have been devised by Portland, Ore., musician. On the piano before the child is placed a large ferrotype plate on which is pasted a staff of music. The notes, cut out of cardboard and having a small magnet on the back of each, are put in their proper positions on the lines, the magnets holding them in place. After the child has visualized their position and can play them on the instrument the notes are shifted easily and quickly to a different position for further work.

Below, at left, are the essential parts of a filter holder for your microscope. The base is a large pipe cap and the clamp was made from a piece of brass rod. In circle, filter of gelatine sheets between glass is held in the filter holder ready for use beneath the lens

MAKING AND USING A MICROSCOPE FILTER



The shed skin of a spider, which discloses much about the physical equipment of the creature, is here being arranged for study under a dissecting microscope

...h a picture of the shed skin of a ... er, the fang on the chelicera is ... ay seen. The fang is hinged so it ... be folded down like a knife blade. Through its center runs a poison duct

Colored Light

A Simple Addition Increases Efficiency of Your Microscope When You Study the Tools and Activity of a Master Weaver

■

WHEN you leave the world of ordinary things behind and with the aid of your microscope, go on an exciting journey into the Land of the Invisible, you find your trip enlivened by color. The green chlorophyll of plant tissues, the red corpuscles of blood, and the colored crystals are a few examples of natural coloring.

The most important thing about color in microscopy, however, is the fact that you can use it to help you see things that otherwise would be indistinct or invisible. If you make photomicrographs, you cannot escape for long the use of color.

The process of employing color to improve the performance of your lenses is so simple that you will encounter no difficulty whatever in applying it. You simply insert a piece of colored glass or other colored, transparent material into a beam of artificial light focused to illuminate the object you are examining. Sometimes you can use two or three colors at once. The colored glass is called a screen or filter.

There are several reasons why a microscopist uses filters. For one thing, the lenses of many microscopes perform better in light of one color. Another reason is that, by using light of certain colors for illuminating specimens that have been treated with a dye, maximum contrast or detail can be brought out as desired. A third benefit lies in the fact that blue or green filters make long observations less tiring on the eyes. A fourth reason is that, in making photomicrographs, filters can be manipulated to control results. For instance, a section of yellow whalebone photographed by blue light would be rendered with great contrast, while red light would bring out the detail of the structure.

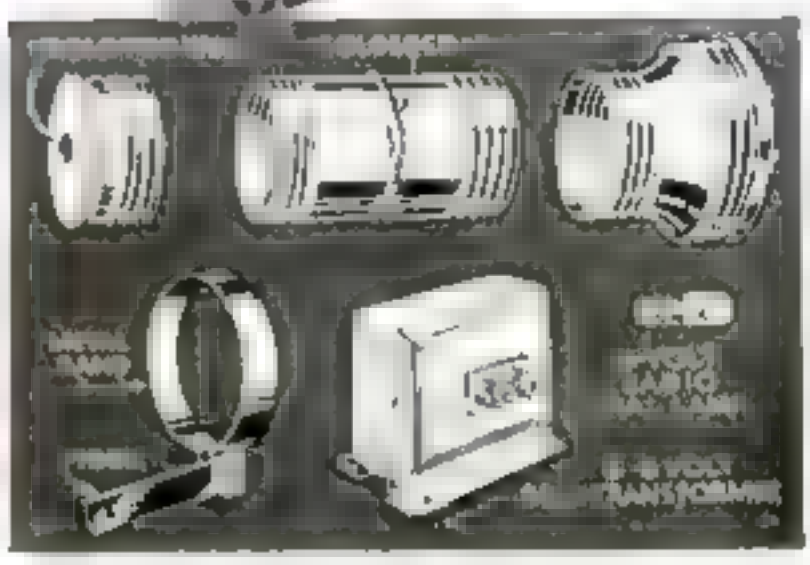
If microscope makers had but one color of light to contend with, their lives would be far easier. As it is, they must create lenses that are to be used in white light, and white light, as you know, is a mixture of many colors each of which behaves differently when passing through a lens. Laboratory microscopes, having achromatic lenses, are corrected for two colors (with reference to chromatic aberration).

This means that the lenses bring two colors of the spectrum to sharp focus, while other colors are not so sharply focused. Higher-grade instruments, having apochromatic objectives, are corrected for three colors. As for the cheaper microscopes, it is doubtful if the lenses will bring more than one color of light to sharp focus at one point. The presence of color fringes about images indicates that perfect color correction is lacking.

The writer has a microscope that cost, when new, about $10. It magnifies to 125 times. Simple tests with a set of three-color photographic filters, that is, pieces of gelatine stained scarlet, green, and blue-violet and known to photographers as the "A," "B," and "C" filters, revealed

A colored gelatine filter is being held in the light path under the microscope to discern its effect. With a cheap instrument a filter helps because an ordinary lens in a cheap instrument usually works better in the light of one color

In circle the eyes of a spider usually eight in number. In this specimen they are clear and brilliant. Below, diagram showing how to make an illuminator like the one at the extreme left



Aids Your Microscope

By
Morton C. Walling

that the microscope focuses all three of these colors at different points. When the image was rendered as sharply as possible by daylight, the insertion of any one of the filters into the beam of light falling on the mirror caused an apparent shift of focus. Refocusing would make the image sharp when the filter was in use. Then if the filter were changed, refocusing was necessary. You will find that some filters, particularly when two of them are used together, absorb so much light that you may have to increase the illumination. On the other hand, filters reduce to a comfortable level the brilliancy of illumination that otherwise would be undesirable.

There are so many factors involved in the use of filters that no set of rules can be given in the space available. Color of the object being examined, correction of the microscope lenses, amount of detail or contrast desired, all must be taken into account. It is not always desirable to use a filter. A good microscope will perform well in white light. However many microscopists find that pure white light is tiring to the eyes, particularly when they spend hours on end watching the antics of an active paramecium or rotifer. By inserting a blue or green filter into the light beam, such fatigue can be avoided or at least reduced.

Many microscopes come equipped with a blue viewing filter that slips into a holder below the sub-stage condenser. You can purchase blue or green filters in gelatine form or as gelatine cemented between glass. A flask of copper-sulphate solution, placed in the light beam, is preferred by some workers as a means of making the light easy on the eyes.

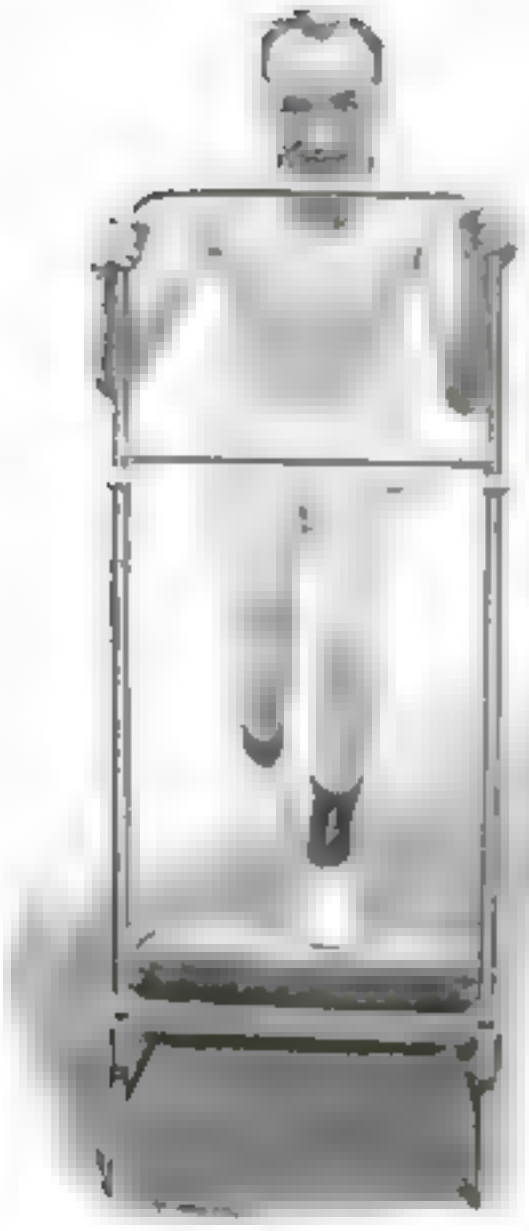
You need not go to a lot of expense to procure a set of visual filters. Although expert microscopists probably would shudder at the idea, you can build up a useful collection by procuring pieces of colored cellophane or similar material, bits of colored glass, and old photographic filters. Many store owners can give you pieces of the transparent material they use for coloring the light from their show-window illuminators. You can stain bleached out photographic plates or films with household dyes. Use either a plate that has not been developed but has been cleared in hypo fixing bath, or one that has been bleached by any of several methods, such as immersion in tincture of iodine followed by clearing in ordinary hypo solution.

At a cost of about ten cents per square inch, you can purchase special microscope filters in gelatine form. These are made by dyeing thin sheet gelatine. They must be handled with care because the gelatine will be damaged if touched with the fingers. Two- or three-inch squares of gelatine are preferable. There are a number of visual filters obtainable in this form.

In addition to the gelatine filters you can buy numerous photographic filters. There is available a set of nine two by two-inch gelatine filters for photomicrographic work, at a cost of about $3.10. Most of these can be used as visual filters.

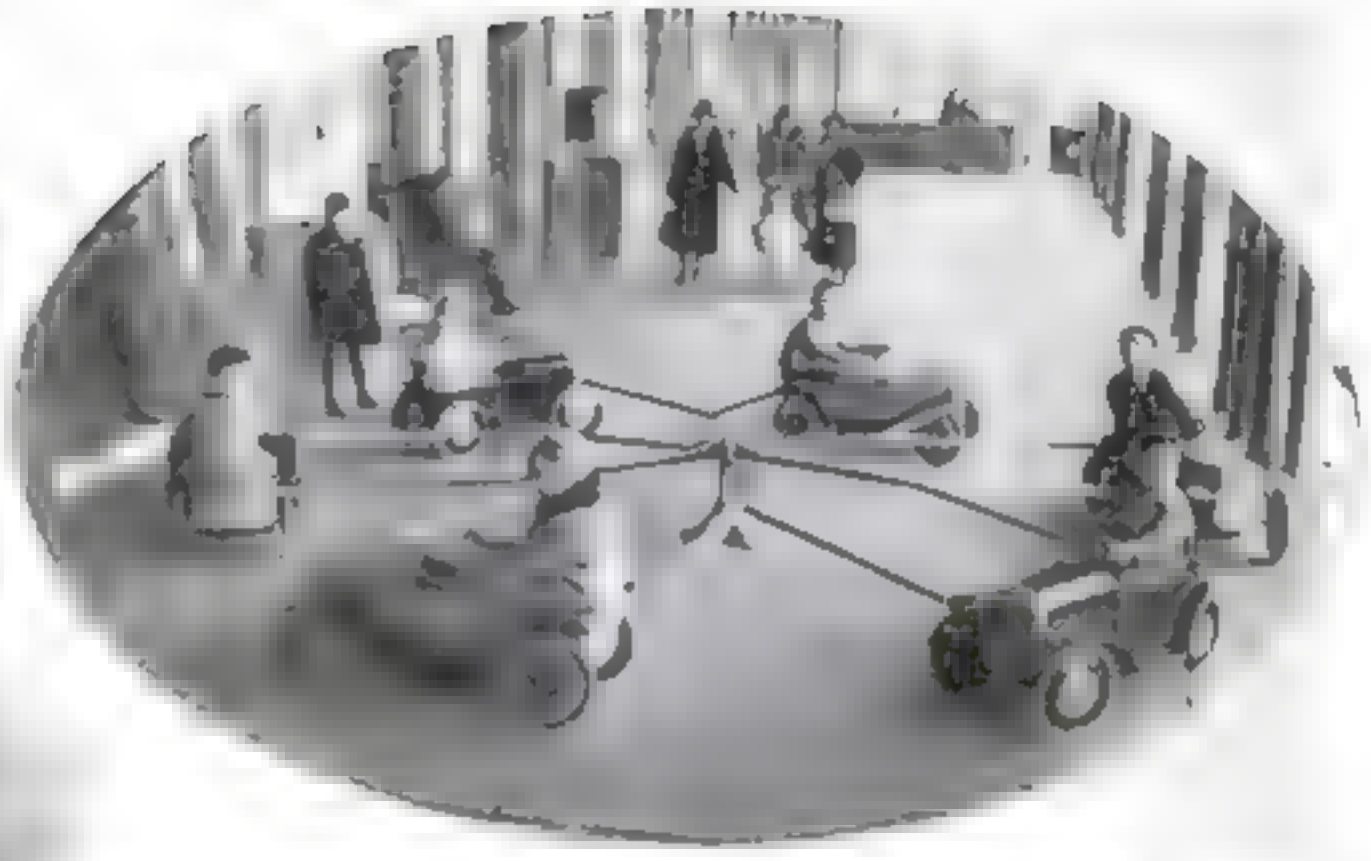
Filters made of gelatine, cellophane, and other fragile material should be mounted between glass or in cardboard frames to prevent damage when handled. A good way is to cut pieces of glass to a size about one-eighth-inch larger all around than the filter itself, and then sandwich the gelatine between two glass pieces whose edges are bound with lantern-slide tape. This method is satisfactory for all kinds of microscope filters because they are placed in the beam of artificial light and therefore do not interfere with the light rays after they have left the object or passed through the lenses.

For holding the filters, you can construct a little stand that is adjustable to almost any position. Make a wood holder by cutting grooves in two blocks measuring about one and one-half inches long, one inch wide and five-eighths-inch thick. Cut the grooves about three-sixteenths-inch deep, and space them one-half-inch apart, measured on centers. Fasten the blocks to a base piece five-sixteenths-inch thick, one and one-half inches wide and long enough to permit the filters to be slipped into the (Continued on page 92)

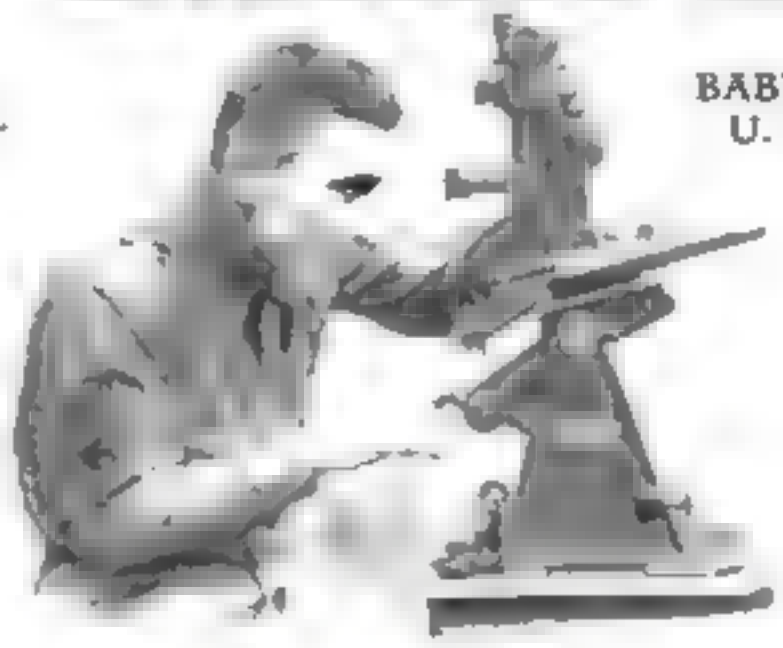


RUNNERS USE TREADMILL AS TRAINING TRACK

A ONE-MAN training track for runners is part of the equipment recently installed by an English sporting club. The device consists of a small treadmill platform with an upright pipe frame in front. Gripping the frame, the runner begins his workout, a speedometer at one side of the apparatus indicating how fast he is going. Speeds up to twenty miles an hour are recorded by the machine. Because of its construction the treadmill enables runners to work in a small room.



NEW MERRY-GO ROUND OF MIDGET AUTOS



BABY CANNON ADDED TO U. S FIELD ARTILLERY

LATEST addition to the artillery of the United States Army is a midget cannon, just large enough to take a .22-caliber cartridge. It is built exactly to scale, one inch to a foot, and reproduces in all essential details, the larger guns. It enables artillerymen to practice sighting, elevating, and firing, without the expense of costly, large-caliber ammunition. In calculating the trajectory of the projectile, the gunners' work is simplified.

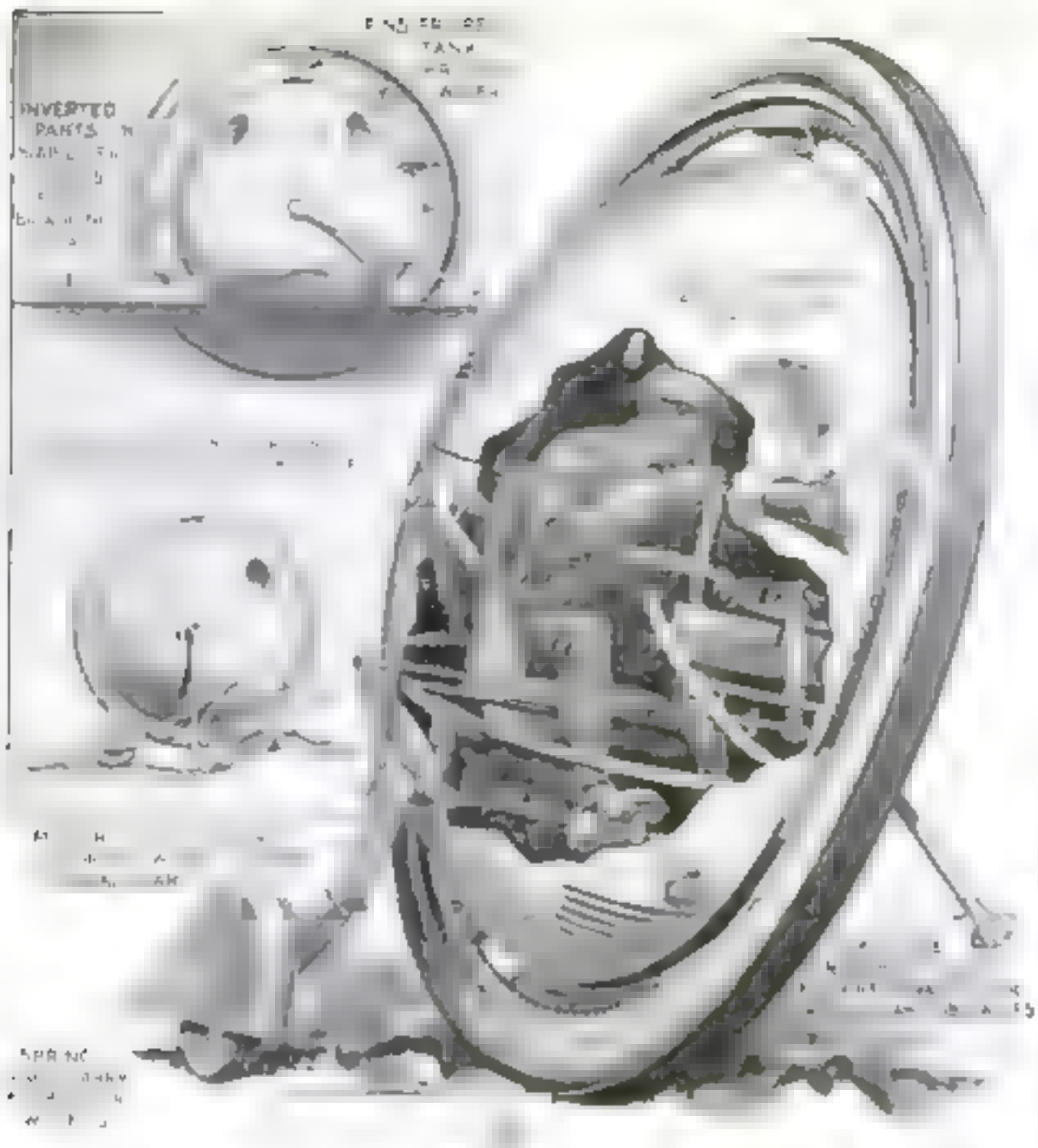
PORTABLE HOMEMADE ELECTRIC WELDER BUILT OF JUNK

Portable homemade electric welder that was built of odds and ends at a cost of $400

BUILT of junk parts at a total cost of $400, a portable electric welder, which does the work of a $1,300 machine, has been constructed by two California workers. Besides its low original cost, it has the added advantage of lightness, weighing but a fraction of the conventional welder. A chassis from one type of automobile, a four-wheeler motor from another and a radiator from still another were used, while the generator was obtained from an electric milk truck.

To increase the water capacity of the cooling system a three-inch pipe was connected to the radiator at two points. This pipe also forms a strengthening member in the chassis frame. A fifteen-gallon gasoline tank, self-starter and instrument panel complete the outfit, which can be rolled about by hand easily. It will weld a half-inch rod at 800 revolutions a minute, the builders report.

War Tank ON One Wheel OPERATED BY ONE MAN



This one-man war tank propelled by a hidden motor would roll into action as is shown above. The diagrams also give us a clear idea of how the machine runs on land or water

SUDDENLY, through the drifting smoke of a hard-fought battle, rush weird, one man fighting tanks. They have the appearance of disk wheels and roll like hoops across the battlefield. Pouring out machine-gun fire they leap over trenches, vaulting across on a range steel crutches to pursue the disorganized enemy.

Such is the startling vision foreseen by a New York inventor. He has just obtained a patent upon a unicycle-type tank which he believes will revolutionize battlefield tactics.

Housed inside the armored body, the operator will steer the single main wheel by means of two small auxiliary wheels at the rear. A turn of the handlebar lifts one stabilizing wheel and lowers the other, shifting the balance of the machine and turning it to one side or the other. An internal gear mechanism, operated by a motor inside the body, drives the wheel ahead at remarkable speed.

By a simple process of inverting the streamlined pants on the stabilizing wheels, so they form balancing floats, and attaching propelling fins to the main wheel, the tank can be turned into an amphibian capable of plunging into a stream and rolling to the other side.

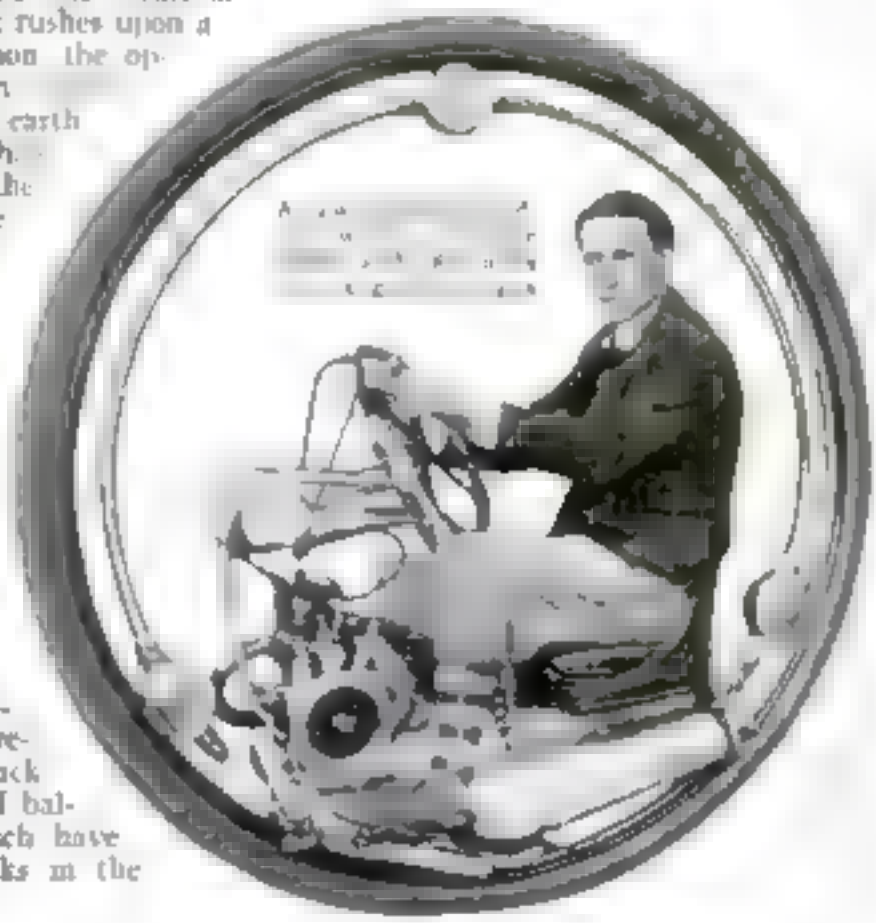
TURNING HANDLEBARS STEERS TANK BY LIFTING ONE STABILIZING WHEEL AND LOWER NG OTHER TO SHIFT BALANCE OF MAIN WHEEL

One of the oddest features of the revolutionary machine is formed by the steel-tube crutches that project ahead on either side like medieval lances. As the tank rushes upon a trench or obstruction the operator will drop th so they dig into the earth and the whole mach will vault through the air to the other side.

An open-type form of the vehicle, which is shown on our cover, has also been devised by the inventor. Without the armored body or the crutches it is designed for highway use.

In various parts of the world, recently, engineers have been reviving the idea of the unicycle. Attracted by the economy and compactness of a one-wheeled vehicle, they have been attacking anew the problems of balance and propulsion which have been the stumbling blocks in the path of the inventors.

In England, an Italian inventor has just demonstrated a single-passenger unicycle in which he claims to have reached speeds of 100 miles an hour and to have made 280 miles on a gallon of gasoline. In the near future he plans to bring the machine to the United States and demonstrate its adaptability to American highways. Perfected after more than ten years of experiment, this odd machine rests solely upon one huge pneumatic tire encircling the driver, and dispenses entirely with exterior steering apparatus. The metal rim within the tire supports the frame and driver's seat and is rotated by a motor of one and three-fourths horsepower. To guide the vehicle to left or right, a steering wheel just below the central frame with respect to the wheel shifts the driver's weight and thus steers the hoop. Models of various sizes are contemplated, the diameter of the hoop being suited to the height of the driver, so that a tall man, according to the inventor, would use a larger unicycle than a short man.



STUDS REMOVED WITH ORDINARY WRENCH

Studs are removed without the aid of a large Stillson wrench if a simple little device consisting of a hexagon-shaped block of metal with a knurled hole running through it, is used. A groove, cut from the side to the hole, holds a knurled wheel which revolves on a pin. The device is placed on the stud and then turned with a wrench clamped to the upper hexagon portion of the metal block

STEEL BARREL TESTED IN 200-FOOT DROP

An eighteen-story plunge in Detroit, Mich., recently tested the strength of a new-type beer barrel. Made of steel, the barrel was filled with water and carried to the eighteenth floor of a hotel. Here it was dropped from a window, plunging more than 200 feet to a hard-packed gravel parking space at the rear of the building. The barrel is said to have survived the shock without springing a leak although the side was badly dented. In a second test another barrel was not even dented by the long drop, according to the manufacturer

ROOKIES LEARN USE OF GAS IN WAR

CLOUDS of tear gas rolled along the ground in a spectacular demonstration recently staged for members of the Citizens' Military Training Corps at Camp Dix, near Wrightstown, N. J. Crack men of the Chemical Warfare Service showed the rookies how smoke [illegible] smoke bombs can [illegible] ordinary army rifles. Looking like trowels at the end of long [illegible] they are shot out by [illegible]. When they strike on a [illegible] in the nose the bombs [illegible] once give off volumes of dense smoke that forms a screen

MERRY-GO-ROUND LAUNCHES AIRPLANE

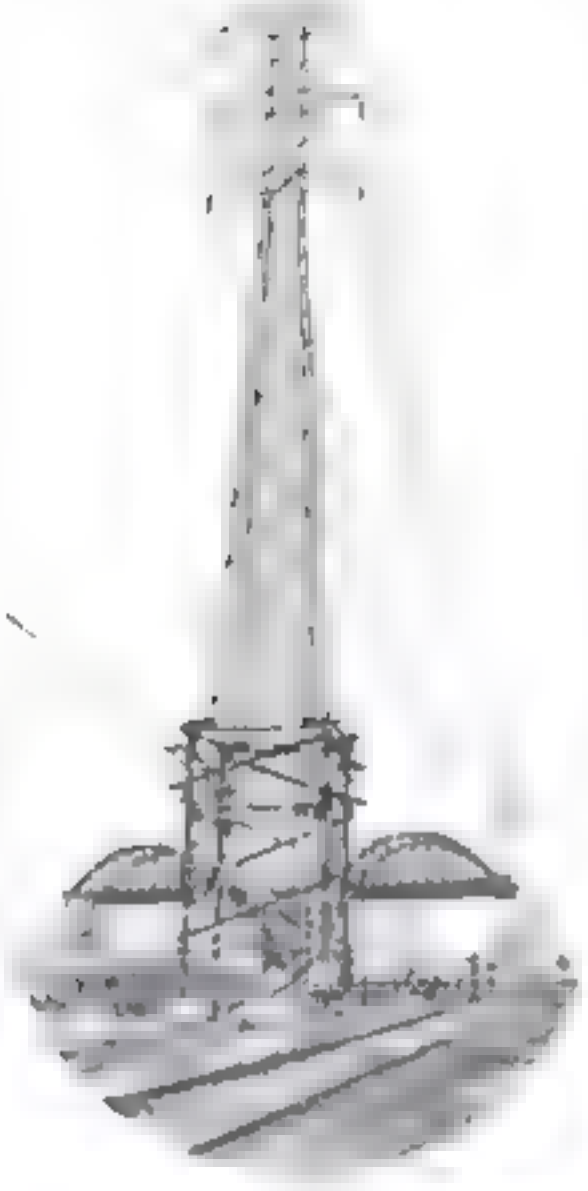
Below, inventor of revolving apparatus to launch planes. At right, the device spinning plane around until it attains flying speed

SWUNG into the air from a merry-go-round launching device, a plane could attain flying speed without the need of a long runway, in a plan proposed by a Denver, Colo., inventor. The device consists of a tall mast with a revolving horizontal boom at the top, from which is suspended a hoop-shaped trapeze. When the plane has been attached to the trapeze and hoisted aloft, the pilot starts his motor. Then the plane revolves around the mast until flying speed is attained, and the pilot frees his craft from the device.

PUMP DRAWS OIL FROM CRANK CASE

ELECTRICALLY-driven pumps remove the oil from the crank case and flush it out in an ingenious apparatus for filling stations recently marketed by a Pennsylvania manufacturer. It makes it unnecessary for the attendant to crawl under the car, open a pet cock and let gravity drain the crank case The oil is sucked into a glass tank where the motorist can see the condition of the lubricant and decide whether to have it changed. If he wants it changed, the attendant merely throws a switch and the oil changer flushes the crank case. If the oil is in good condition, a reversible pump forces it back into the crank case. A basket-type strainer, in the suction line, enables the motorist to see the grit, babbitt metal particles, and other foreign material drawn from crank case

Electric-driven pump draws oil from car's crank case



LIFT TWO HIGH-TENSION STEEL TOWERS 25 FEET

LIFTING two 147-foot steel towers, each weighing 28,000 pounds, twenty-five feet straight up into the air without disturbing the high tension wires they carried, was the hazardous engineering feat recently accomplished near Los Angeles, Calif The work was necessary to provide sufficient clearance for a new bridge crossing under the wires. It was done during the morning calm to avoid the possibility of a side wind toppling over the high steel structures, and special precautions were taken to insure that all four corners were lifted at exactly the same rate. To bear the tremendous load, a framework of twelve by twelve-inch timbers, forty feet square, was erected at the base of each tower Five-ton gear blocks did the lifting while men with steel tapes stood at each corner keeping accurate check upon each fraction of an inch the tower rose. Two hours work did the job.

NEW PARCEL POST SCALE SHOWS EXACT POSTAGE

SHOWING the exact postage as well as the weight of a parcel post package, a new weigher is said to cut by half the time of handling heavy mail. Electrically-operated, the device is equipped with a "local" lever and eight zone levers, in addition to a weight indicator. When the package is in place and the weight has been indicated, the zone lever is pulled, as at left, and instantly the required postage is shown. In this way the time necessary to weigh and stamp a parcel is greatly reduced as what was two processes is made one. The increase in the volume of parcel-post business made a machine of this kind essential.

TOOL CHEST FITS IN POCKET

All tools shown here fit pocket-size case

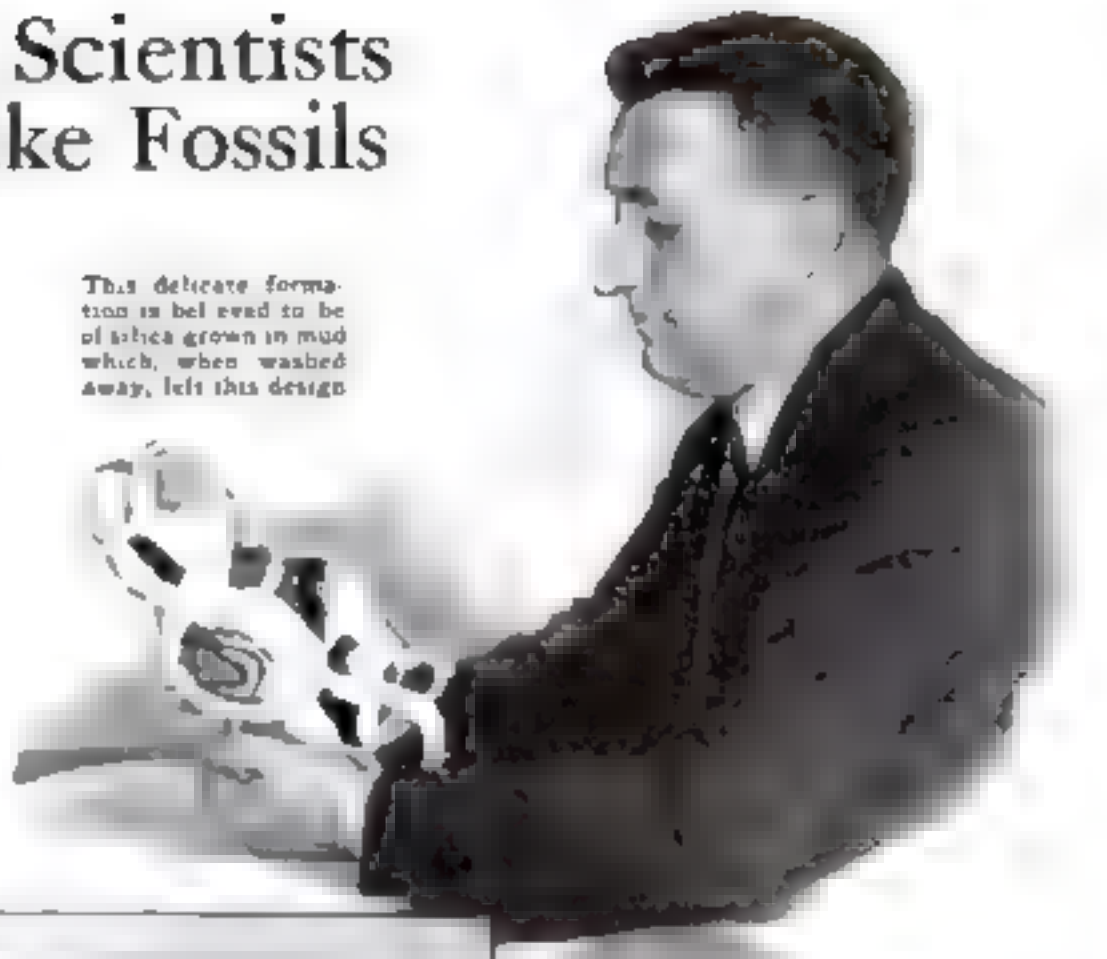
A VEST POCKET tool chest combining twenty-five different tools, including hand drill, hammer, and screw driver has been put on the market by an eastern manufacturer. The various attachments, when not in use, are housed in the hollow handle of the hammer. When the head of the hammer is removed, the other attachments can be inserted in the handle, a small crank on one side operating the drill and bit. While the combination tool is so small it can be carried in any pocket, it is sturdy enough to stand hard usage and meet any emergency demands made upon it, the maker states

WRIST WATCH MEETS GRUELING TEST

WHIRLED by an airplane propeller, dropped 1,200 feet from the sky, left under water for hours, and hurled full force against a stone wall, a new wrist watch of special construction recently continued to tick and keep accurate time. The manufacturer reports that neither vibration, shock, nor change in temperature affects the operation of the timepiece. The shatterproof crystal can be struck with a hammer without damaging it. Shockproof construction and hard metals are said to account for the performance of the watch.

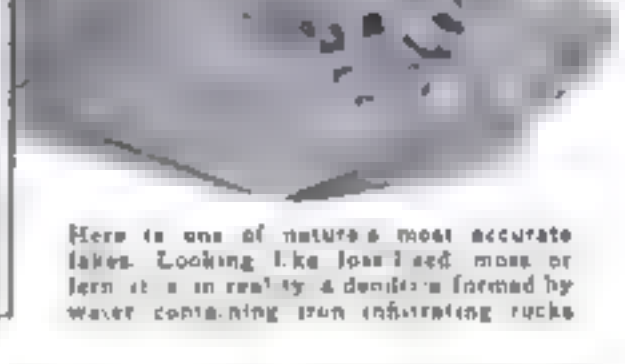
Nature Deceives Scientists With Strange Fake Fossils

TENDED as carefully as if its specimens were genuine, a collection of fake fossils is one of the most curious possessions of the Smithsonian Institution, Washington, D. C. So realistic are some of these natural counterfeits or pseudo-fossils, as they are scientifically known, that amateur collectors have shipped them to the institution in the sincere belief that they were genuine relics of prehistoric animal or plant life. Nature played a prank, for example by creating a rock that strongly suggested a fossil snake. Actually the lapping of waves formed ripples on mud that later hardened to rock. Another specimen, apparently a fossil plant embedded in white quartz, in reality was produced by the infiltration through the rock of water containing iron or manganese oxide. The Smithsonian collection also includes "fossil turtles," "fossil eggs," and odd formations of stone that deceptively resemble bones.



This delicate formation is believed to be of algae grown in mud which, when washed away, left this design

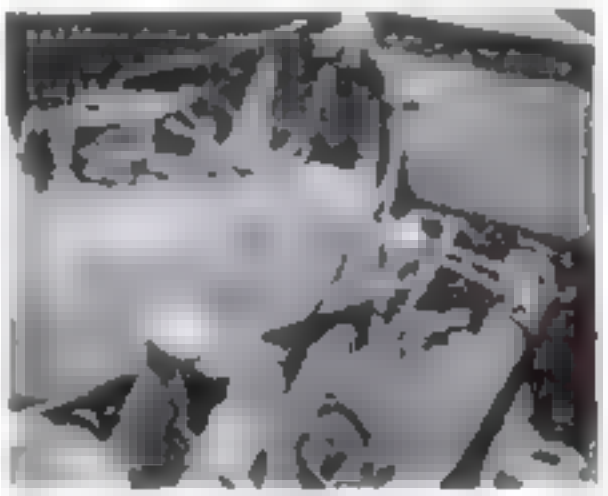
This fossil turtle isn't what it appears to be. It is a geological formation that grows on rocks. Pressure distorted this one to its present shape. At upper right the fossil backbone is merely vegetable and mineral matter built up through the centuries. Below is mysterious coil that strongly resembles a snake. Next to it a fossil heart formed by mud holds a clam shell



Here is one of nature's most accurate fakes. Looking like fossilized moss or fern at a glance, it is in reality a deposition formed by water containing iron-saturating rocks

RAIL BUS HITS SEVENTY-MILE SPEED

Its blunt, streamlined nose cutting the wind at seventy miles an hour, a new high-speed bus that runs on rails, had its trial recently on the London Northeastern Railway, in England. Driven by Diesel-electric power, it is said to have proved both more economical and more flexible than the ordinary steam locomotive which is pictured beside it at the King's Cross Station, London. The new rail bus is the latest English entrant in the world-wide race for faster and economical rail travel described recently in POPULAR SCIENCE MONTHLY. (P S M Aug. '33, p. 9). Its initial test is said to prove it is the equal of any similar bus hitherto produced, but cars now under construction in America may surpass it



NEW SPARK CONTROL WORKS AUTOMATICALLY

AUTOMATIC control of the spark on motor engines is secured by means of a device recently demonstrated. It consists of a rigid tube with a diaphragm bellows and a flexible tube running from the bellows to the intake manifold. The rigid tube and bellows replace the present spark-control rod. Vacuum, created in the car's manifold by the running speed operates the control. Thus a high vacuum advances the spark and a low vacuum retards it. The spark by this means is kept in the position of greatest efficiency. Claims made for the control include quick pick up, smooth idling, less engine labor on hills, and fuel economy. Though automatic in design, it can be operated by hand if the driver prefers.

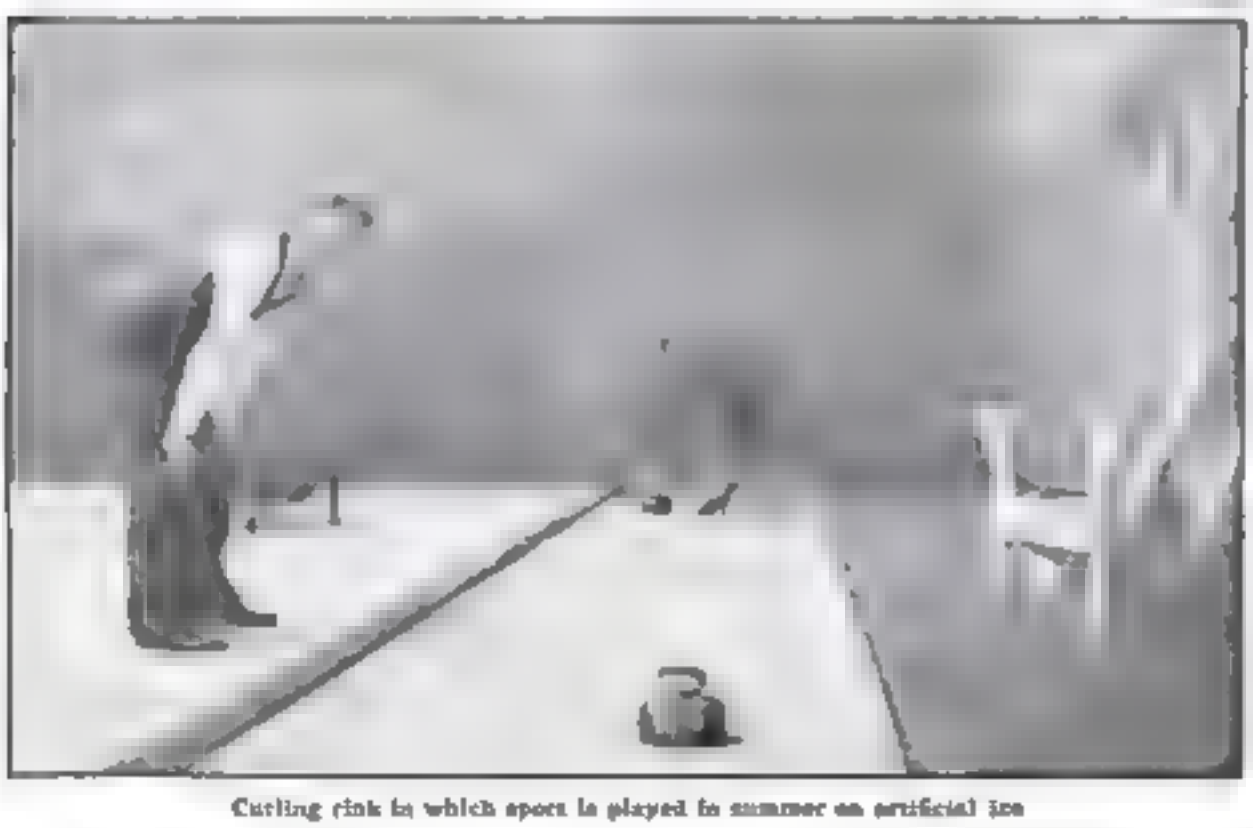
TWO KINDS OF RUBBER IN NEW INNER TUBE

MADE of two kinds of rubber with a valve that is not fastened to the rim, a new inner tube is designed to resist tear and mutilation in low-pressure tires. It consists of inner and outer rings of rubber that do not tear easily, and are heat-resistent. These rings are vulcanized into one piece during manufacture. To eliminate tearing caused by the valve stem when the tire goes flat, engineers designed a new type of valve assembly. The entire valve unit slips through the hole in the rim and is held by air pressure

Inner tube at right, showing valve that is not attached to rim. Below, view of two kinds of rubber in tube

USE ARTIFICIAL ICE FOR SUMMER CURLING

CURLING, a winter sport played on level stretches of ice, has been made a year-around pastime by a California innovator who has opened a curling rink paved with artificial ice. This chemical substance does not melt and can be used over and over again. The stones are thrown so they slide over the artificial ice.



Curling rink in which sport is played in summer on artificial ice

TELEVISION BY SPINNING MIRRORS

TWELVE whirling mirrors and ten stationary ones form the heart of a new television projector devised by a young Los Angeles Calif. inventor Thomas Sukumlyn. The stationary reflectors face the screen and are set at different angles and tilts. Beams of light, thrown from the twelve spinning mirrors, are reflected from the stationary ones to the screen to form the image. In the past, television projectors have employed drums containing as many as several hundred mirrors arranged around the edge and spinning at tremendous speed. By simplifying the construction, Sukumlyn says he can project images with great fidelity

COFFEE TESTER FOR UNCLE SAM

OFFICIAL Coffee Tester for Uncle Sam is the title of H. A. Lepper of the Department of Agriculture Washington D C It is his job to pass on all coffee purchased for the Army Navy veterans hospitals and even for the inmates of Leavenworth and Atlanta prisons. After samples have been given various tests, coffee is brewed from each and the results are then graded by him.

H. A. Lepper, the Government's coffee taster, is seen grading samples

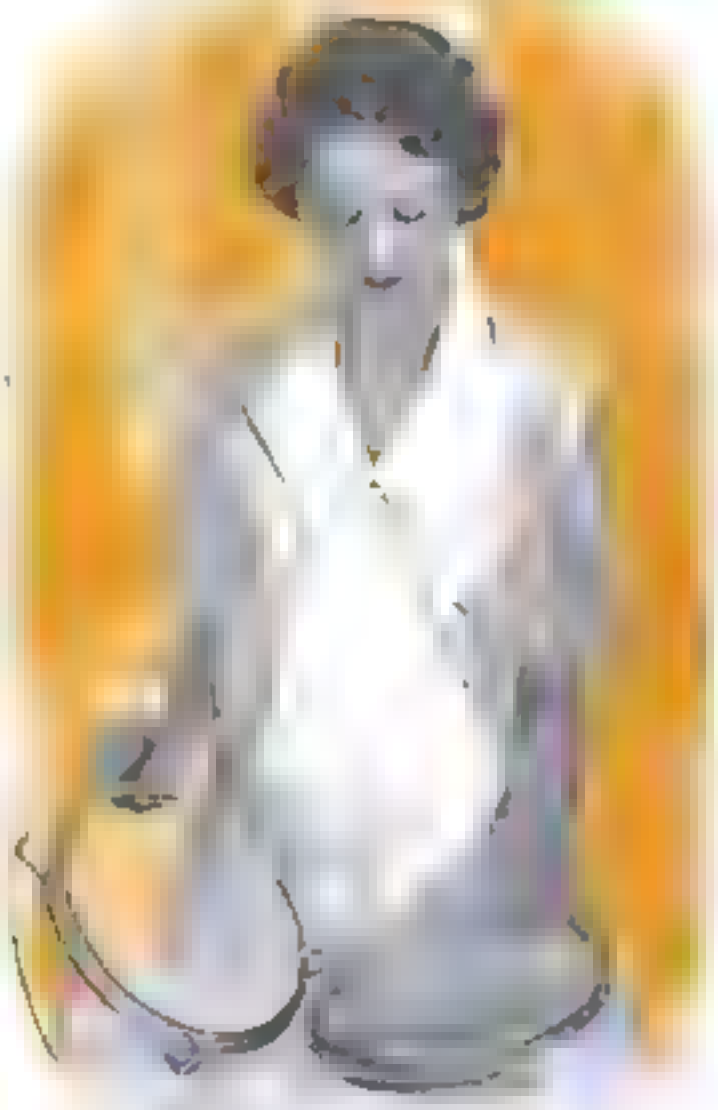
NEW DEVICE MAKES DEAF HEAR THROUGH TEETH

A SMALL-SIZED portable device that enables deaf persons to hear through bones and teeth has been developed by Dr Hugo Lieber of New York. The method which is known as bone conduction, dispenses with the outer and middle ear as channels of sound, and carries vibrations to the inner ear by way of teeth or head bones. Earlier efforts to produce a small device using this principle have met with the obstacle that small vibrators would "freeze" if the necessary power was transferred to them. Dr Lieber's invention, he claims, has overcome this difficulty In the new oscillator, power has been increased and the converted sound vibrations are conveyed to the bones of the head by the housing of the oscillator instead of by a small disk.

Helpful New Tools in

GRATER CAN'T HURT YOU There are no sharp teeth on this veg- e able g ater so there s no chance to cut or scratch the hands wh- e us ng t

SPRING PUNCH OPENS CANS. In- side the canned-milk opener, shown below s a spring and trigger Press- ing the point against the can com- presses the spring and at a certa n point the trigger releases the spring which drives the point through the can



INDIVIDUAL GLASSES A set of four g asses, each n a d fferent color comes in a special rack The set s des gned for use in a fam- y bath room

of which has a cut- ter to snip off the desired length The box has room for sewing accessories

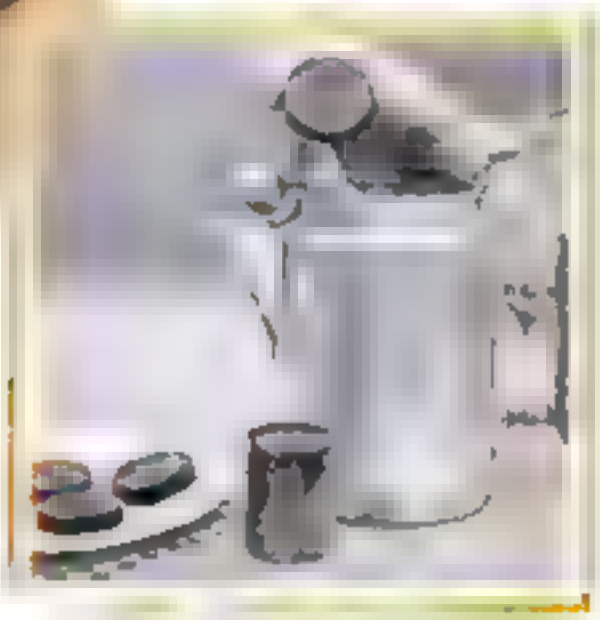
NEW DESIGN IN OIL HEATER Desiring to pro- duce a heating cabinet that would not clash with the other furnishings in the room, a new oil heater has been designed so attractive it adds to any room s appearance

the Household

ELECTRIC CASSEROLE Plugged in to any electric outlet, this kitchen utensil will cook a dinner dish for eight people, without the manufacturer says wearing any of the natural ju ces. The inner container is made of heavy gage aluminum and it is said to be unbreakable It operates on 325 watts high heat and 200 watts, at low heat

PAPER CAPS FOR JARS. No metal is used in these new jar caps which are made of paper that has been impregnated with wax They are eas ly put on and removed and securely seal a jar

NEW WAY TO COOK EGGS No clock is needed to time eggs when the outfit shown above is used. Eggs are placed in the container and boiling water poured over them until it reaches the desired minute mark Tiny holes in the bottom let it escape and eggs are done when water level reaches lowest mark

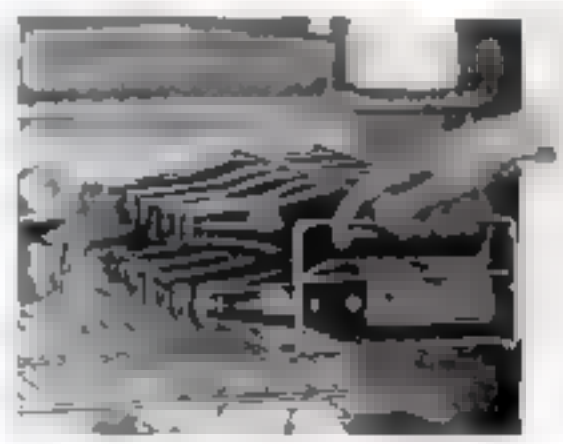


COFFEE DISKS FOR THE HOME. There is no variation in the amount of coffee placed in pot if these disks are used. Each contains the same amount of coffee

SALT FORCED OUT Inside this salt shaker is a conical plunger that forces the salt forward and expels it The shaker works with damp salt

HOLDS AND DRAINS SPOON. A wire clamp holds this spoon rest securely to the edge of a saucepan or other cooking utensil Upon it the spoon is laid to drain and keep it handy for use

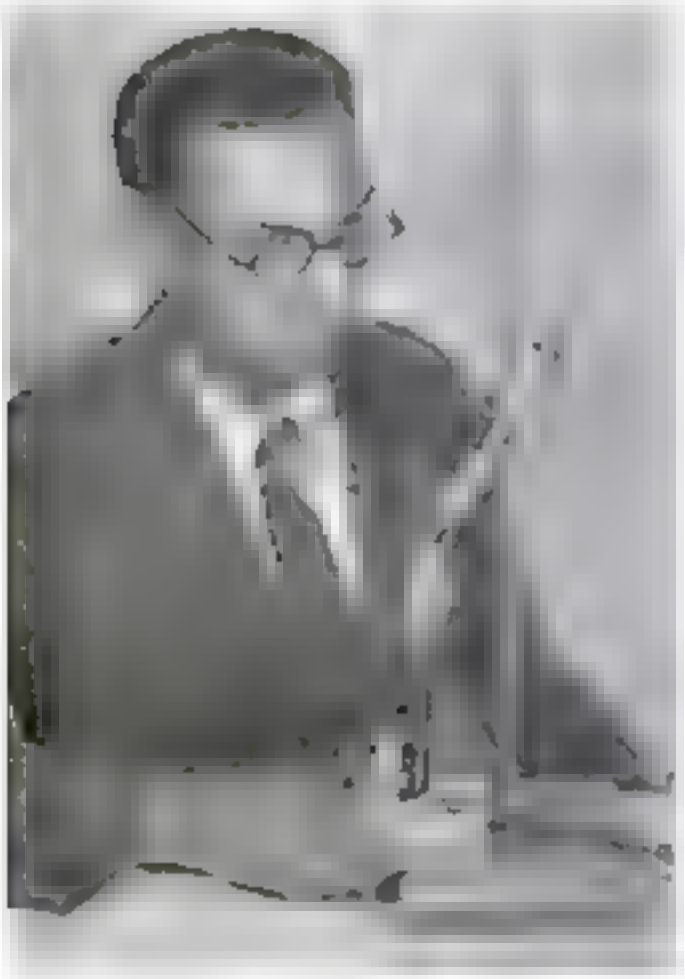
TABLET FOR SALT A pure mineral-composition tablet, when placed in salt shaker keeps the salt running freely even in the most humid weather The tablet absorbs the moisture but does not change the salt



RACK FOR BOTTLED BEER. Refrigerator space is economized when this rack is used to hold bottled beer Eleven bottles can be placed in it and then put in refrigerator without removing a shelf

Crime-Detection Tests

FOR THE *Home Chemist*



The nature of iodine is heated in a large test tube to evaporate the alcohol. The iodine rises in the form of pungent vapor but is readily deposited in the flask as iodine crystals

FINDING LOST FINGERPRINTS

If a thumb is pressed against a dry piece of paper no visible marks are left. When this paper is exposed to iodine vapors, however, in the manner shown at the right, the print, like one above, is visible

By
RAYMOND B. WAILES

NEW thrills await the home chemist who experiments with iodine. Besides its queer properties and varied uses, it serves as the gateway to a new branch of chemistry—the mysterious and interesting art of scientific crime detection.

With iodine, the amateur experimenter can transform his home laboratory into a miniature crime bureau. In a few hours he can master some of the chemical tricks that aid the modern sleuth in his search for hidden fingerprints, clever check alterations, and forgeries.

First, however, the amateur must learn how to obtain this active element in its free state. For years, it was recovered commercially from a giant type of seaweed called kelp. Now it is obtained from the solutions left behind when Chile saltpeter is crystallized in large quantities.

Its solution in alcohol, commonly known as "tincture of iodine," furnishes the home chemist with an easily obtained source. To free the solid iodine, it is necessary only to heat the tincture slowly and carefully to drive off the alcohol.

This is best accomplished in a large test tube. After the alcohol has been entirely evaporated, pungent-smelling gases will rise from the tube. These will be the characteristic violet-colored vapors of iodine.

Although this heavy vapor should not be breathed in any quantity, its peculiar odor reminds us of our experiments with chlorine. In fact, although it is a solid at ordinary temperatures, the characteristics and activity of iodine closely parallel those of gaseous chlorine.

No scrubbing bottle or absorber will be needed in our experiments with iodine since the dangerous vapors condense readily on the cool walls of the test tube. Chemically speaking, iodine sublimes, that is changes from a solid to a gas and back to its solid form again.

It is the violet, pungent vapor of iodine that forms an important weapon in the scientific detective's bag of tricks. To demonstrate one of its most important uses, press your thumb against a sheet of white paper. No image of the lines and pores of your skin can be seen. However, if the paper is brought in contact with vapors of iodine, the thumb print will appear, well defined and clear cut. Even after several months, this system can be used to uncover hidden clues.

These same vapors of iodine also are used by the scientific sleuth to discover forgeries. Untouched paper can be identified from paper rubbed with bread crumbs or an eraser. Dry paper can be distinguished from paper that has been wet and redried, by the color developed by the iodine vapors. Iodine also brings to light any marks or depressions made in paper with a blunt object. The invisible indentations will stand out clearly in a strong violet color when placed in the vapor.

When experimenting with iodine it is best to obtain the solid chemical from one of its compounds. While tincture of iodine can be used, the solution contains such a small amount of the element that results are not always satisfactory.

Potassium iodine, for instance, is an excellent source of free iodine since it can be obtained at any drug store. Simply mix it with manganese dioxide and add strong sulphuric acid. Immediately, the violet-colored vapors will appear. By heating the tube or flask containing the mixture, the quantity of iodine produced can be increased.

A simple piece of apparatus for making and collecting the iodine is shown in the illustrations. The mixture is placed in a test tube and an inverted glass funnel is so mounted above the tube that the iodine vapors released will travel up the funnel stem and condense. It is a simple matter then to scrape out the crystals that are formed and store them in a glass-stoppered bottle. If you find that the vapors condense on the upper portions of the test tube instead of in the funnel, heat that portion of the tube also.

Like chlorine, iodine combines readily with many other elements. Zinc powder (zinc dust) and iodine crystals when mixed react slowly to form iodide of zinc. If, however, a drop of water is allowed to fall on the freshly prepared mixture, the combination is instantaneous. A hissing noise is heard and the violet-colored vapors of free iodine can be seen.

Aluminum powder (aluminum bronze used in making paints) and iodine crystals heated in a test tube unite to form aluminum iodide. As the reaction takes place, a vivid glow will be produced. When cool, a few drops of water added to the test tube will decompose the substance with the evolution of heat.

Mysterious iodine explosions can be set off in the home laboratory by mixing nitrogen and iodine (nitrogen iodide.) To make this compound, crush or grind some iodine crystals in ammonium hydroxide

How Hidden Fingerprints May Be Found by Using Iodine Vapor — Forgeries Also Are Revealed by This Remarkable Element

Wires of different metals are coated with mercuric iodide and shellac. When heated, as shown, they will change color, thus showing how fast each of them will conduct the heat

If mercuric iodide is dissolved in a solution of potassium iodide a liquid results so heavy stones will not sink in it

(household ammonia will serve). Be sure to keep the crystals under the liquid and stir frequently for an hour or so. Then pour off the liquid and collect the black nitrogen-iodide crystals, placing them on pieces of paper.

As these crystals dry, you will note a peculiar property. Each crystal will explode at the slightest touch and a violet cloud of iodine will puff up from the chemical. In fact, the substance often will explode spontaneously. The explosions, which are harmless, will sound like those of small potash caps.

This strange chemical phenomenon is caused by the violent decomposition of the nitrogen iodide. Moist, it is a stable compound, but dry, it decomposes so rapidly that it explodes.

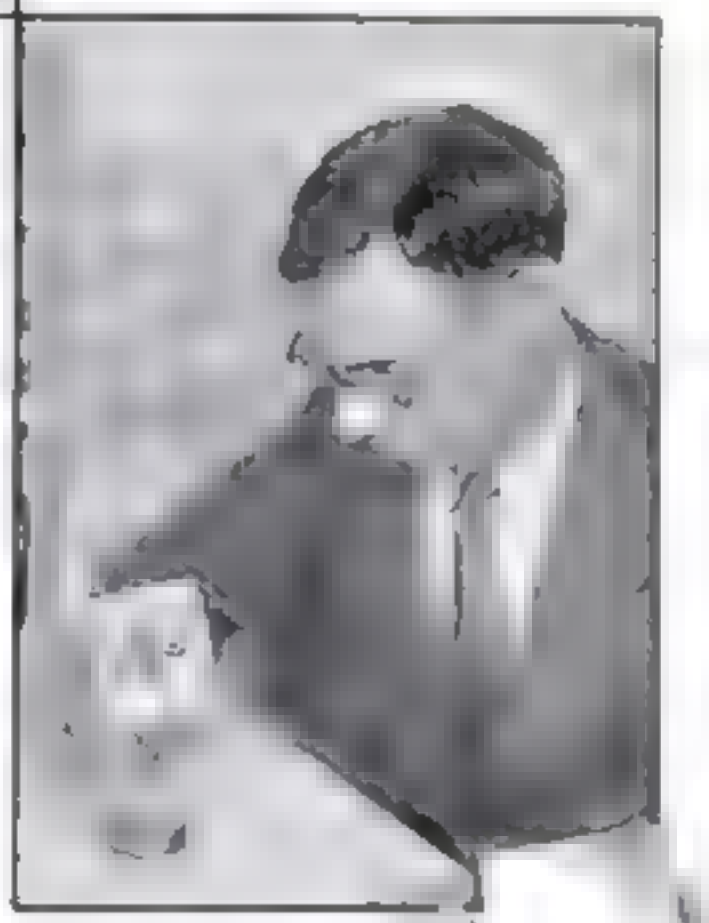
When mercury and iodine unite to form mercuric iodide they open the way to many interesting experiments in both chemistry and physics. At room temperature, mercuric iodide is a red powder. However, when heated to about 150 degrees Centigrade, it changes mysteriously to yellow. Because it displays this property, mercuric iodide is often referred to as being *enantiotropic*. This color change is due to a change in the crystalline form of this mysterious substance.

In time, the yellow mercuric iodide will return to its original red color. Unaided, this change may require two or three days, but it can be brought back in a few seconds by "painting" the substance with a dry brush or by stroking it lightly with your finger.

Although mercuric iodide can be made by heating a mixture of mercury and iodine in a test tube, such a process would be costly, especially, since it can be made in large quantities simply by adding a solution of mercuric chloride (bichloride of mercury) to a solution of potassium iodide.

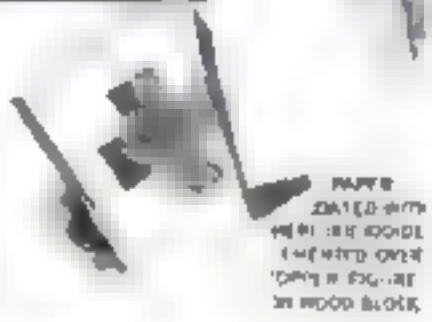
When the mercuric-chloride solution is added, a red precipitate will be formed. As this dissolves and disappears add mercuric chloride solution to form more of the precipitate. To get a complete reaction, test the top liquid from time to time, as the precipitate settles, by adding more mercuric chloride. If a precipitate forms, more of the solution must be added. Continue adding and testing until no precipitate is formed.

When the reaction is finally completed, allow the red precipitate to settle, pour off the clear liquid and add fresh water. Repeat this process several times to wash the precipitate and remove any chemicals still in solution. Finally, the mercuric iodide can be filtered off in a paper funnel, dried, and placed in a bottle.



MYSTIFYING EXPERIMENT

A cross, cut from copper, is fastened to a base of wood, and white paper is pasted over them. Paint the paper with red mercuric iodide. When heated the paper not in contact with metal quickly turns yellow



PAPER COATED with RED MERCURIC IODIDE COVERS CROSS

IN WOOD BLOCK

The precipitate can be scraped from the filter paper with a spatula made by rounding the edges of a strip of thin celluloid. An iron or metal knife should not be used since it is likely to combine with the chemical.

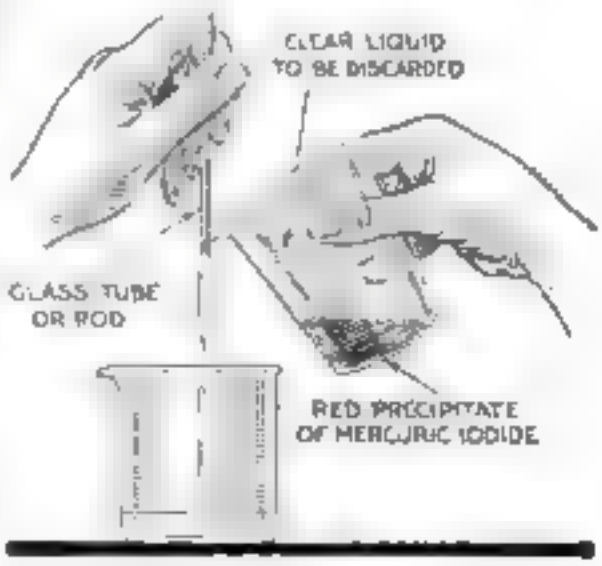
A simple yet mystifying experiment with heat can be performed with this red powder. To prepare the apparatus, fasten a cross or other figure cut from thin copper to a thin square of wood, using a cement of the type formed by dissolving scraps of celluloid in acetone. Then cement a sheet of white paper over the metal figure and wood base and apply a thin coat of red paint made by rubbing some of the red mercuric iodide you have made with cement or weak shellac.

When the paint has dried, hold the red square near the flame of an alcohol lamp or gas burner. Gradually, the portions of the paper not in contact with the metal will turn a vivid yellow, while the paper covering the cross will remain unchanged.

This color-changing property of mercuric iodide also can be used by the amateur chemist to show the relative heat conductivity of metals. First, obtain wires of several different metals and coat them with shellac or some variety of paint. Then after they have dried, coat them with a paint made by mixing iodine with some base such as shellac.

When this final coat has dried, arrange the wires so they project into the flame of an alcohol or gas burner. The ends of the wires will soon become hot and the rapidity with which the heat is conducted along their lengths will be shown by the change in color from red to yellow.

A peculiar, heavy liquid can be made by dissolving mercuric iodide in potassium-iodide solution. The resulting fluid will have such a high specific gravity that stones, glass stoppers and other heavy objects placed on its surface will float.

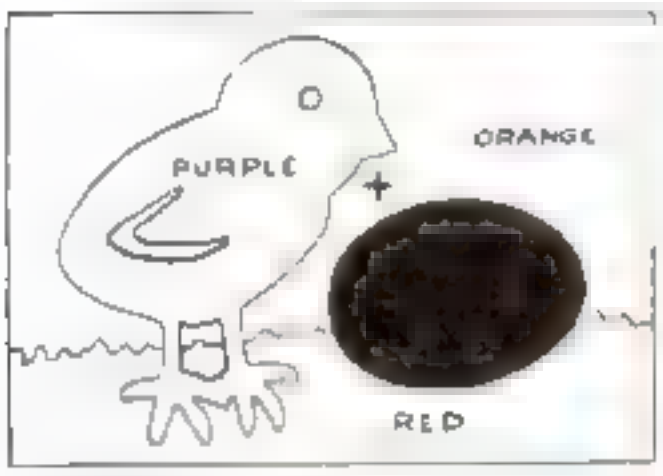


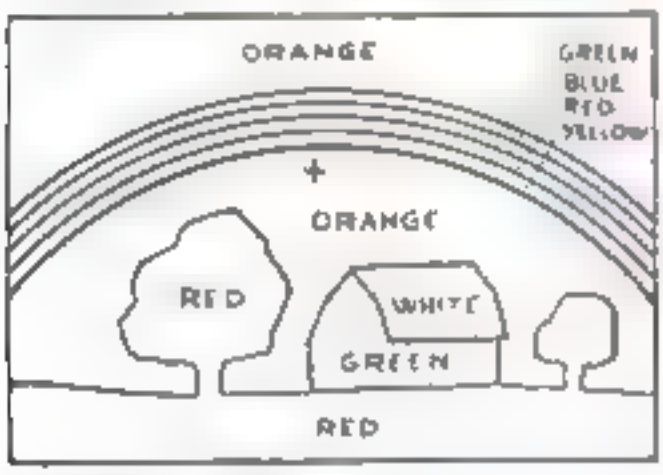
MERCURIC IODIDE can be obtained by adding a solution of mercuric chloride to a solution of potassium iodide and stirring. A red precipitate of mercuric iodide is formed. The clear liquid is poured off, leaving the precipitate

Seeing GHOSTS

NOW EXPLAINED BY SIMPLE EXPERIMENTS

Holding it in a bright light, look fixedly at a piece of white paper upon which you have drawn and colored the figure seen at left. Then when you look at the wall, its ghost appears with hood green and the skull white





If you trace on white paper and color as indicated, the figures shown in the two at one above you can see them as ghosts on the wall, each object appearing as a dim y-seen figure in its complementary colors

quickly looking away, stare fixedly at a white, dimly lighted wall.

In two or three seconds, you will see a pale green hood appear, to be followed by a white skull. After three or four seconds, the vision will fade away.

The green color on the ghost's hood is due to the fact that prolonged staring at the red hood tired the retina so it became temporarily less sensitive to red. As a result, when you look at the wall, the retina responds only to the red's complementary color—green

Similarly, the black skull tests the retina and makes it more sensitive to the reflected light from the wall which accordingly shows you the black pattern in the white, ghostly outlines of a specter

GHOSTLY, sheeted figures, seen as one runs past a dark cemetery, are not merely figments of the imagination. They are actually seen as real ghosts looming out of the night.

This is the conclusion arrived at by psychologists who now claim that people really see with their own eyes the apparitions that form the bases of "true" ghost stories.

According to these psychologists you can, at will, see synthetic specters, in the following manner

To see a white skull, covered with a green hood, trace the outlines of the skull, which is seen on this page, on writing paper with a pen and jet black ink. Fill in the black parts carefully and then with wax crayon or water-color make the hood red.

To see the ghost, hold the drawing in the light of a white electric bulb and stare steadily at the skull's nose for fifteen or twenty seconds. Then,

Now trace off and color the outline of the two pictures seen in the first columns. After being looked at steadily for a few moments, the ghosts of the pictures will appear on the wall as a yellow chicken, white egg, green ground, and blue sky. The other figure will show a green tree red barn, and the rainbow in its correct order of colors.

Psychologists have proved that these after images can, occasionally, be retained by the retina for a surprisingly long time. For example, let us suppose that one who was frightened by the graveyard spook had recently seen a human figure silhouetted in black against a lighted doorway. Experiments show that it would be possible for him to carry this after image in his eyes and to see the same figure as a white ghost against the dark trees

One experimenter saw the after image of an object on the wall of his room on awakening from a whole night's uninterrupted sleep. This makes it easy to explain how people wake up and see ghosts moving about their rooms, leaning on the foot of their beds, or peering in at the windows. Each ghost is the after image of some person who may have been seen against a strong light several hours before

Another interesting experiment explains the type of ghost seen when one carries a candle about in a dark house.

Hold a lighted candle two or three inches before your nose and move it slowly from side to side. In a short time you will see the network of finely branching blood vessels on your eye's retina, outlined against a dull red background. Also you will see near the center a light spot. This is the fovea, or point of most distinct vision.

How easy it would be for an apprehensive person carrying a candle or small lamp, to perform this experiment unconsciously and to mistake the fovea for a dimly seen head with some of the blood vessels forming the folds of a cloak. Doubtless this is the secret of the ghosts seen in old "haunted" houses

CREATING A GHOST

Looking steadily at a moving candle will give you an image of the eye's retina and fovea, as seen at right. The fovea is the white dot. Seen in a dim light the fovea and retina may become a ghost

Radio Noises Reduced by DOUBLET ANTENNA

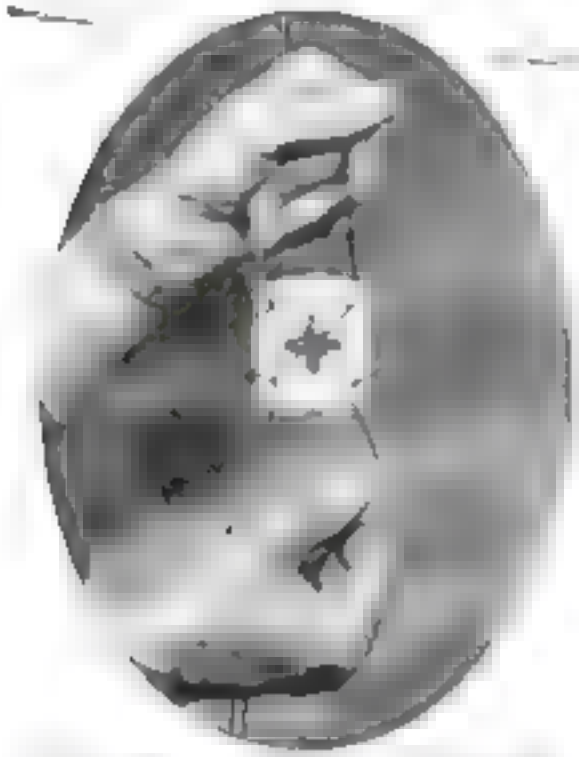


Illustration shows how transposition blocks are inserted at each corner of the insulator blocks are designed to receive wires

NO MATTER how sensitive or selective a short-wave receiver may be, best results can be obtained only with a well-designed antenna. True, any sort of wire, haphazardly rigged, will bring in results. But a carefully installed and insulated system will give that extra hop that means greater distance and less noise.

While a single wire, strung high, often proves satisfactory, you can obtain infinitely better results with greater selectivity by using some modified form of transmitting aerial. Of these, the so-called doublet system with its noise-reducing transposed lead-in, offers the greatest flexibility and best signal to noise ratio.

If you operate a transmitter, the doublet antenna will not be new to you. The same system can be used for reception in a somewhat simplified form. Basically it consists of two separate wires rigged on insulators in the same straight line. The length of each doublet or wire is equal to one quarter of the wave-length to be covered by the set-up.

Although this constitutes a tuned system, a receiving antenna of this type designed for eighty meters, will cover the forty- and twenty-meter bands as well. Similarly, a forty-meter system will bring in the twenty-meter stations.

To figure the length of each doublet simply decide on the maximum meter band to be covered, multiply by 3.28 to convert the meters into feet, and divide by four. The result will be the doublet length in feet between insulators.

The doublet system is connected to the receiver by means of a transposed lead-in. Because of its ability to prevent man-made static noises from entering the system as it approaches the building, the lead-in is an important part of the set-up.

Diagram showing how a doublet receiving antenna is installed and how reactivated

A transposed lead-in is connected to a doublet receiving antenna in the manner shown. Note transposition blocks used to cross wires

Although two insulated wires, connected to the doublet and transposed or twisted, will serve as the lead-in, best results are obtained when two lengths of antenna wire are transposed or crossed through inexpensive transposition blocks. How these blocks are used is shown above.

The lower ends of the transposed leads can be connected into the receiver in several different ways, simplest of all being directly to the antenna and ground binding posts of the circuit. Of course, when this is done no ground connection is used. If the lack of a ground produces noises and hums, special couplers can be used for quieter reception.—J. F. Q.

Wire Nail Cuts Sheet Aluminum

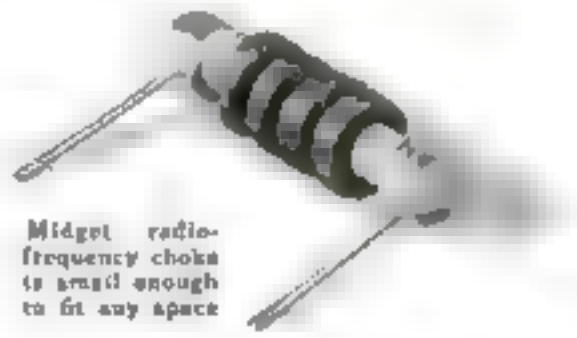
A sharpened wire nail is used to score both sides of sheet aluminum, as shown above, when it is to be cut for panels, brackets or small chassis parts

LACK of tools need not prevent you from cutting your own brackets, panels, and small chassis parts from sheet aluminum. You can do the job easily and quickly with an improvised cutter made by filing or grinding an ordinary wire nail to a three-cornered point.

Simply rest the aluminum on a hard surface, hold a metal straightedge (a length of angle iron will serve) along the line to be cut and, using the sharpened nail like a pencil mark deep scores on both sides of the sheet. Press down firmly on the nail and go over the cut several times to make it deeper. Be sure, however, that you follow the line of the straightedge.

Then, holding the sheet flat on your bench top with the scored lines directly over the sharp corner of the edge, bend the metal first one way and then the other. After a few bends, the metal will part along a smooth, even break. If any rough edges should result, they can be filed.

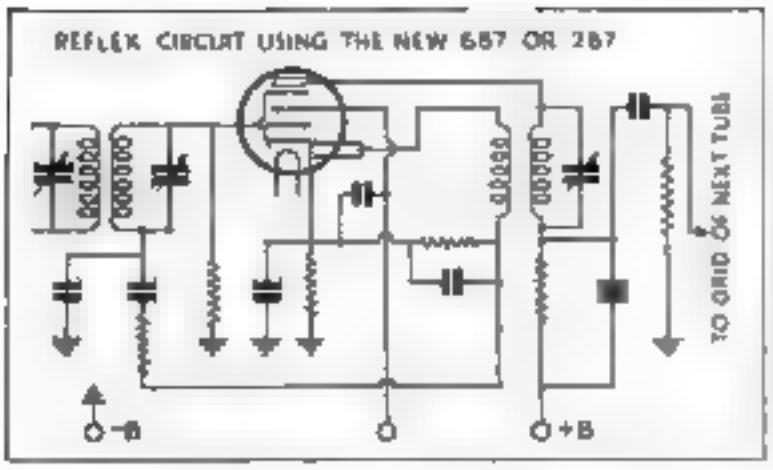
When much cutting is to be done, mount the nail in a wooden awl handle and resharpen the point frequently. For best results, hold the nail so that one angle enters the metal first.—G. J. D.



Midget radio-frequency choke is small enough to fit any space

Midget Radio Choke Requires No Mounting

A MIDGET radio-frequency choke is the latest compact part for short-wave receivers. Light enough to be hung by its own leads, it requires no mounting and can be fitted into the circuit in any available space. Because of its four-part winding, it is said to be an improvement over the usual single-layer type and serves for low-power transmitter work as well as high-frequency reception. Where a mounting is desired, it can be inserted in the conventional resistance clips.



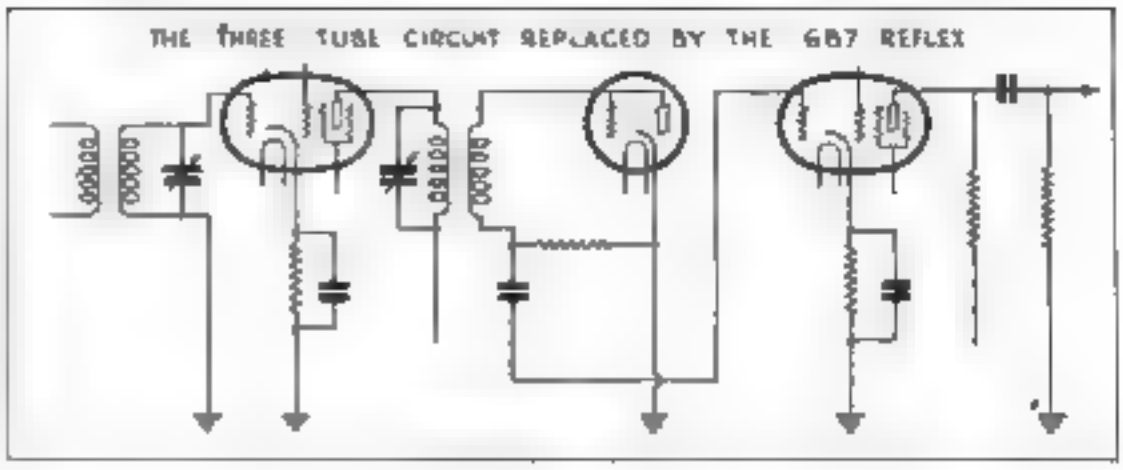
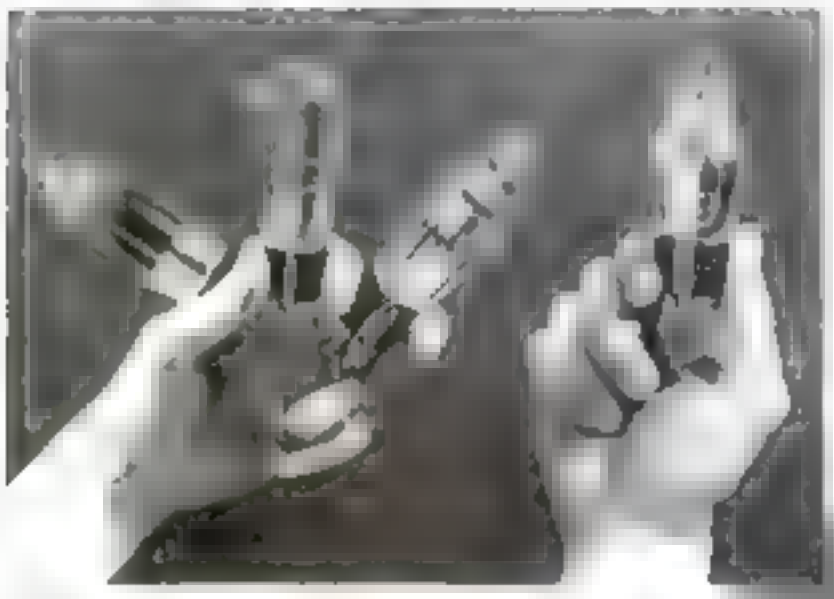


Diagram at left shows the reflex amplifier circuit using the 6B7 and above a diagram of the circuit that it replaces

Three Tubes in One *bring back* Reflex Circuit



At upper right is the new 6B7 tube. At its left are the three tubes that it replaces when used as a combination reflexed amplifier and detector

By George H. Waltz Jr.

AIDED by new developments in tube design, radio engineers have dug into the past for the latest in compact circuits. Using a new duplex tube, they have resurrected the once popular reflex hook-up

Years ago when tubes, parts, and batteries were expensive, radio fans resorted to a special circuit that allowed them to use a single tube to amplify simultaneously both radio and audio signals. Energy picked up by the antenna was first amplified by a vacuum tube, then rectified by a crystal detector, and finally rerouted to the same vacuum tube for the audio amplification

Parts were saved, fewer batteries were needed, and expensive vacuum tubes were eliminated. Because it turned the signals back over the same course, this arrangement became known as "reflexing"

Today, the old reflex circuit has been revived in a slightly different form and for another reason. Public interest in midget receivers and high-grade sets for automobiles has started an intensive search on the part of radio engineers for newer and more compact circuits. Economy of current drain is an important factor in automobile receivers and a saving of parts, tubes, and space is a necessity in building pocket-size sets. The reflex circuit offers excellent solutions to all these problems

This is especially so when it is used in conjunction with the newer and better tubes now available. Among these is the new 6B7. With it the old difficulties of the early reflex circuit are overcome

Consisting of double diodes and a pentode, the new 6B7, or its two and one-half-volt brother the 2B7, is in reality several tubes in one. For with its seven useful elements encased in a single bulb, it can be used to replace as many as four ordinary tubes. Connected properly, it can be made to supply simultaneously intermediate amplification, detection, audio amplification, and automatic-volume control. With it many units of a receiver can be rolled into one

How the 6B7 is connected as a reflex amplifier without automatic-volume control is shown in the circuit diagram on this page. The automatic-volume control arrangement has been purposely left out of the circuit for the sake of simplicity

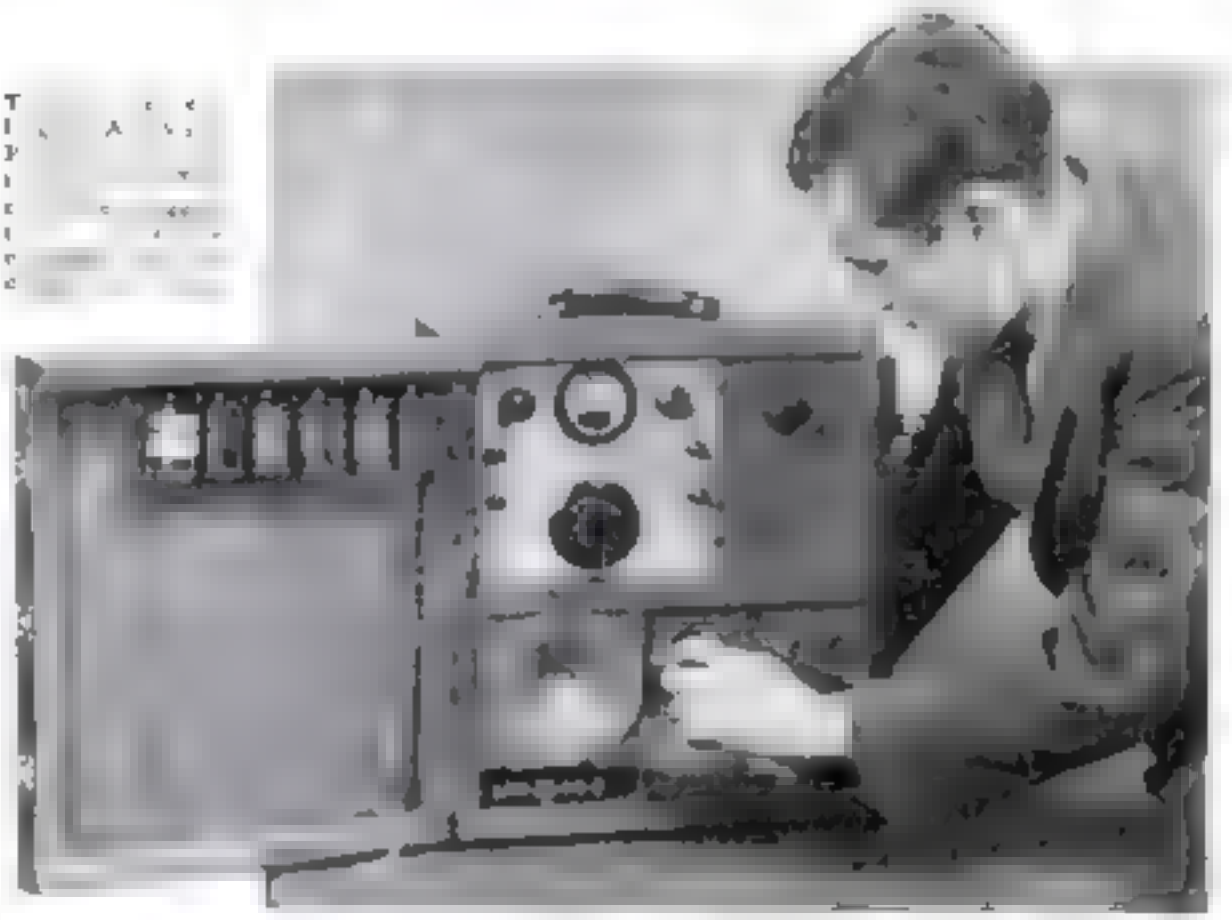
The operation of this reflex circuit using the 6B7, can best be understood by following the signal through the various steps in the system. First, of course, the incoming intermediate-frequency signal is passed into the circuit through the input transformer. Passing through the pentode portion of the tube, it is amplified in the usual way. Then it is fed through the diode, or two-element part of the tube for detection. This rectification produces an audio-frequency signal which is rerouted through the pentode section to receive audio amplification. The pentode portion of the tube in this case is said to be reflexed for the audio- and intermediate-frequency amplification. Actually the reflexed tube replaces three separate units in the receiver, as shown by the comparative diagrams above

Physically, the 6B7 presents what would seem the maximum in compact and complex construction. Being virtually three tubes piled one on top the other the inner construction offers three separate units, connections being made through seven base pins and a single dome cap. Some idea of the construction of the tube can be gained from the cut-away photograph at the left

A 6B7 tube broken away to show its construction. Note how the essential elements are arranged with one on top of the other

Loudspeaker turns

All-Wave Portable *into* Home Set



DESIRING to use the POPULAR SCIENCE MONTHLY All-Wave Portable in their homes this winter many readers have asked if this circuit could be changed for loudspeaker operation.

This can be done easily and inexpensively as is illustrated by the enlarged All Wave Portable constructed by S. D. Dorrance, Jr., and E. S. Fergusson, two enterprising readers. Desiring a good all-wave set to take on a two-month trip to Honduras, they chose Lt. Wenstrom's portable (P.S.M., Aug. '33, p. 54) equipped it with a second audio amplifier and added a small magnetic speaker.

Although the original two-tube circuit was designed to operate on a twenty-two and one-half volt B battery supply, these experimenters found that the set functioned just as smoothly and with increased sensitivity on ninety volts or more. This increase in batteries, of course, meant a larger cabinet and more weight.

However, even with the addition of heavier batteries, a five-inch cone loudspeaker, and seven extra parts, the weight of the portable was increased only to thirty pounds and the cabinet size to fifteen inches high, fourteen inches wide and less than six inches deep.

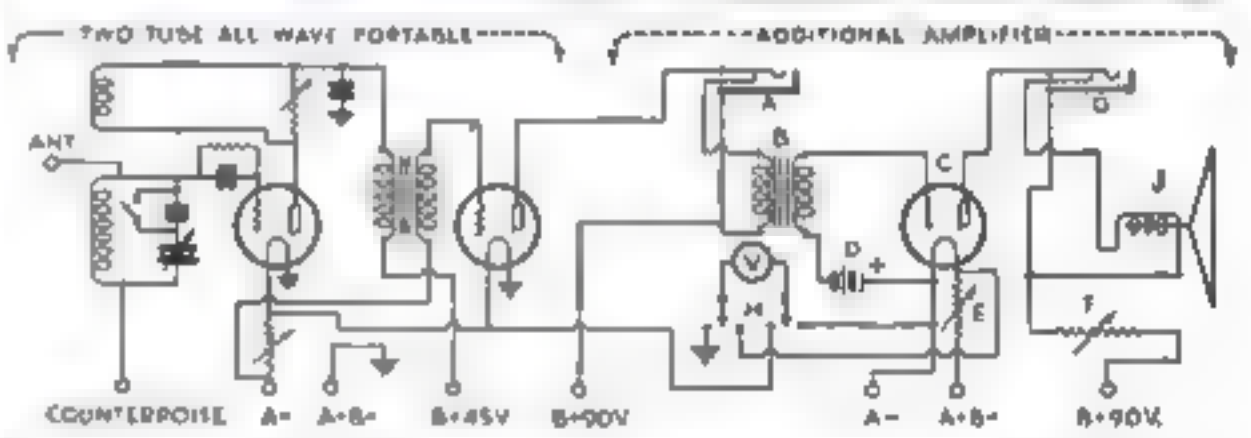
The changes to accommodate the additional stage of amplification were made by altering two simple connections in the completed two-tube set. In fact, the chassis and panel were installed as a unit in the enlarged cabinet.

By comparing the original two-tube circuit with the new circuit shown on this page you will have little difficulty in understanding how this was done. In the first place, the new amplifier stage was connected directly to the two-tube output in place of the earphones. In rearranging the power supply, forty-five volts was used for regeneration and an extra ninety-volt terminal was added for the output. Also, to make it possible to use the voltmeter in adjusting the second amplifier-filament voltage as well as the filaments of the main circuit, a simple double-pole-double-throw switch was arranged.

To provide the greatest flexibility, two jacks were inserted in the second amplifier circuit. The first (A) can be used to connect the earphones directly to the output of the original two-tube circuit and the second (G) serves as an earphone outlet and speaker cut-off for the entire set.

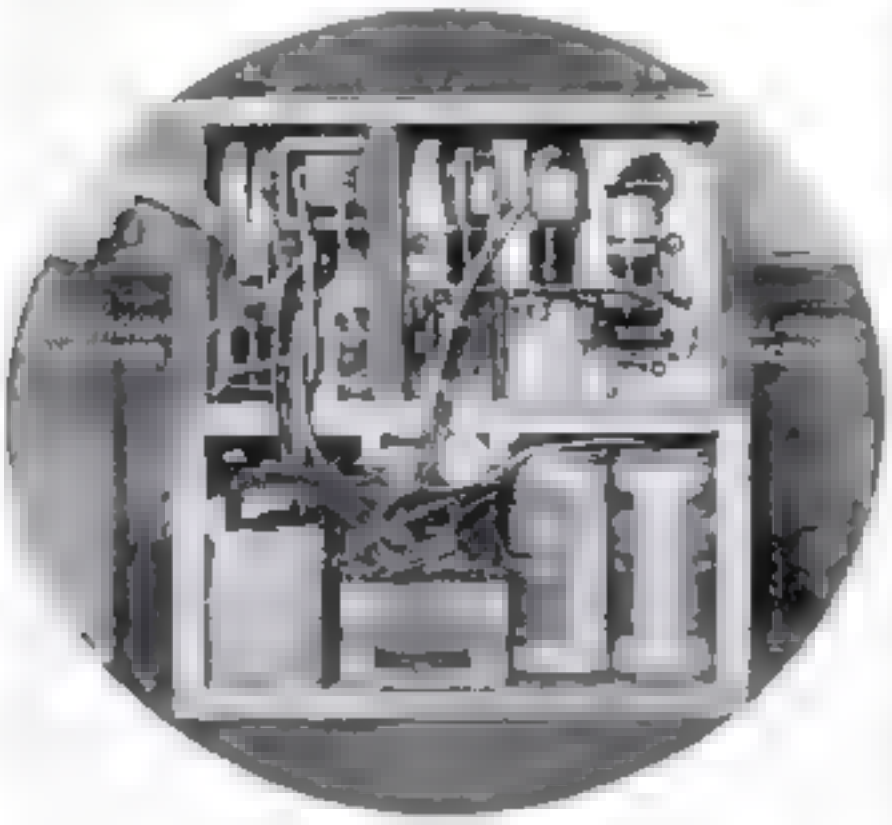
A separate filament rheostat (E) was provided for the amplifier and a 50,000 ohm potentiometer was inserted in the amplifier B supply to provide a control for volume and quality. Although a four-and-one-half-volt C battery is shown in the amplifier circuit, it may be omitted if desired.

How the parts were arranged in the larger cabinet is clearly shown in the photographs. The complete set was installed in the upper half and the batteries, speaker, amplifier-volume control, and voltmeter switch in *(Continued on page 95)*



WHAT YOU NEED
to Add a Loudspeaker

A—Earphone jack, 1st amplifier
B—Small audio transformer
C—Type '30 tube
D—C battery (4½ volts).
E—Rheostat, 10 ohms.
F—Potentiometer, 50,000 ohms.
G—Earphone jack, 2nd amplifier
H—Two-pole, double-throw switch
J—Midget magnetic speaker



Rear view of All-Wave Portable set with the back removed

Speedometers Sometimes Tell Lies

"See these?" Gus asked as he rolled out a pair of gears of different size. "In one complete revolution the small one doesn't go as far as the large one, you see"

By MARTIN BUNN

LOUD voices were coming from the Model Garage when Gus Wilson arrived one morning. Two customers were in the midst of a heated argument.

"Hey, you guys," the gray-haired mechanic shouted as his car rolled to a stop in the driveway, "pipe down. You're waking up the neighborhood." Then he asked Joe Clark, his partner, who was busy unlocking the gasoline pumps, "What's it all about?"

"Got me," the younger garage man said with a gesture of disgust. "All I know is, they've been arguing steady for the last half hour."

"It's about speedometers," one of the men offered excitedly. "Otis, here, says his is right and mine's wrong."

"I'll do more than say it," the other broke in. "I'll prove it."

"Hold on there," Gus bellowed. "Two people talking at once never settled an argument. One of you keep quiet and let the other fellow talk."

Al Taylor caught his breath first.

"It all started about two weeks ago," he began, "when Frank Otis and I decided we'd treat our families to a trip to the Chicago Fair. To make a party of it we planned to stick close together.

"It worked out fine. I'd trail him one day and he'd trail me the next. We kept together every inch of the way, but when we got to Chicago, my speedometer read 970 miles while his read 930. Coming back it was the same way."

"Maybe they're both wrong," Gus suggested.

Both men sputtered indignant replies as Gus walked to the front curb where the two cars were parked.

"Mine's a newer car than his," put in Otis. "My speedometer ought to be nearer right."

"I looked up the mileage according to the roads we took and it checks nearer mine than yours," retorted Taylor.

Gus calmly walked around one car and then the other.

"Say, if you fellows will can the chatter for about five minutes I'll tell you something interesting," he said finally. "In the first place, no matter how good a speedometer is, it rarely clocks the exact mileage after a car's been driven five or six thousand miles."

"Humph!" grunted Otis. "If they go bad that soon, what's the sense of having one?"

"The speedometers don't wear out," Gus corrected. "But your tires do."

"What have tires got to do with it?" asked Taylor.

Gus walked into the garage office and beckoned the others to follow.

"See these?" he asked, picking up a pair of gears that served as paper weights on Joe Clark's desk. "One is larger than the other, isn't it?" The two men nodded.

"Suppose we roll them along this desk top for one complete revolution," suggested Gus, demonstrating as he spoke. "The small one doesn't go quite as far as the large one does."

"Now, let's apply that to the wheels on a car. To start with, speedometers tick off the miles according to the revolutions of the wheels and each one is designed to be used with a certain size wheel. Naturally, if the wheels are larger or smaller than they're supposed to be, the speedometer reading will be wrong."

"How can a wheel be smaller or larger than it's supposed to be?" demanded Frank Otis.

Easy enough," Gus said with a smile. "Tires have a bad habit of wearing out and car owners often forget to keep the air pressure up. In both cases, the tires will be smaller than they should be. If you fit your car with oversize shoes as you've done, Otis, the wheels will be larger."

"I can see how it might make a difference on an old automobile that has the speedometer geared to the front wheel," Otis replied, "but what about the cars that have it geared to the drive shaft?"

"Makes no difference where it's geared," Gus insisted. "It still gets its movement from the wheels and if the tires don't space off the distance they're supposed to, the reading will be wrong."

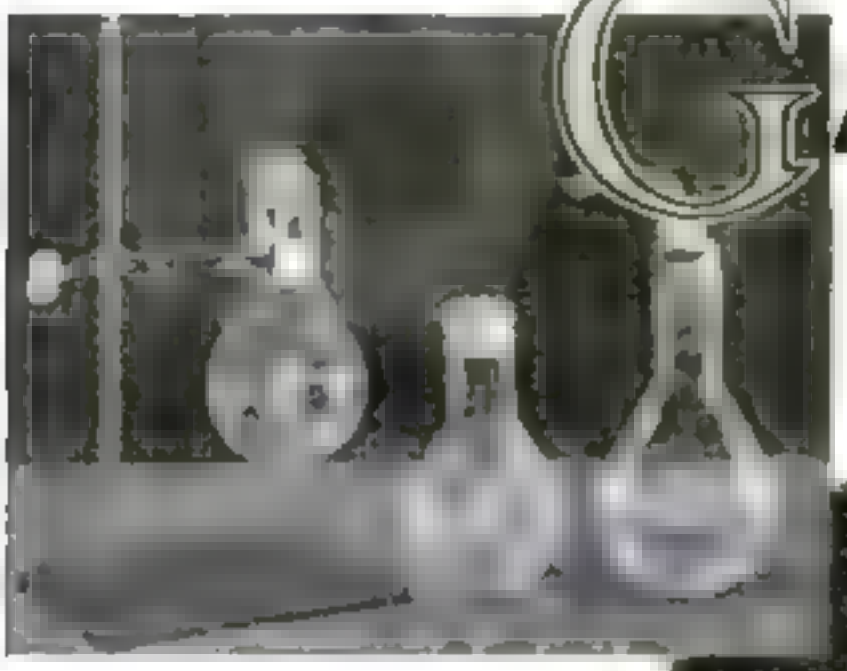
"Gosh! The size of your wheels will make a difference, won't it," exclaimed Taylor. "But forty miles is a big error in a trip to Chicago."

"Let's figure it out in black and white just for the fun of it," Gus suggested as he picked up a scrap of paper and fished for his favorite pencil stub. "Just to make it easy, let's take a car with thirty-inch tires."

Normally, a thirty-inch tire, with a circumference of about seven feet nine inches, will make about six hundred and seventy-five complete revolutions every mile. Since that's the normal condition, the speedometer will be set to tick off a mile every time the wheels turn that number of times. (Continued on page 91)

How to Convert Old Electric Light Bulbs into Chemical Glassware

By Earl D. Hay



Three of the simpler types of flasks made by the author from burned-out bulbs. Long necked flasks and distilling flasks are also easy to make after a little practice

Above, Holding bulb with cloth while enlarging the mouth. *Below*, Filing the threads of a brass cap so it can be stripped away

EXPERIMENTS in an amateur chemical laboratory are much more interesting when they are made with the same kind of apparatus as that used in professional laboratories. As a rule, however, the home chemist experiences a great shortage of flasks and endeavors to use various kinds of bottles as makeshifts, little realizing that he may make from burned-out electric light bulbs a great variety of useful flasks like those sold by chemical supply houses at from 20 to 75 cents each.

The lamps used in the average home vary in size from 25 to 200 watts and are suitable for small Florence or boiling flasks. Larger flasks are made from 300-, 500-, and 1,000-watt lamps, which can be obtained from the janitors of stores and linemen of the city lighting companies.

The methods of working all sizes are the same, and only a few minutes are required to complete a flask.

The method of making a Florence flask washing bottle from a 300- or 500-watt lamp will be described. The flat bottom is made first. Cut off the connection of the center wire on the cap with a knife and break off the end of the slender tube which was used in evacuating the bulb when it was made. This is necessary in order to equalize the air pressure on both sides of the glass wall. Next screw the light into a drop-cord socket to provide a handle for holding the bulb while the large end is being heated over a large laboratory gas burner or a gasoline blowtorch.

The bottom of the bulb is carefully warmed up and then heated evenly to a light red color. Now quickly place it in a vertical position on a level wooden block or an asbestos pad and bear down gently. The spherical bulb will flatten on the bottom. If heated too hot, the bulb will wrinkle and become distorted; if not heated enough, too much pressure will be required and the bulb will be broken.

After the bulb has cooled sufficiently to be handled, remove the brass cap from the neck by filing through the threads on a diagonal line as shown in one of the photographs in order not to scratch the glass with the file. Pull the split cap off with a pair of pliers, and scrape off the sealing wax that lies between the brass cap and the glass, taking care not to destroy the two copper wires leading into the center of the bulb.

As the bulb becomes quite hot while the neck is being shaped, it is necessary to provide some adequate means of hold-

 BLUEPRINTS for Popular Science Monthly projects are listed on page 82.

In making a distilling flask, a small hole is punched through the neck from the inside and a slightly flanged tube of glass is welded on

ing it. If a pair of heavy asbestos mittens are not at hand, a satisfactory holder can be made from a piece of strong cloth by cutting a round hole in it large enough to admit the neck of the bulb. The neck is inserted through the hole, and the cloth folded back over the bulb.

The end of the bulb neck is now carefully heated until the glass becomes red and plastic. With a pair of pliers, seize the two copper wires and carefully remove the glass core by pulling straight out on the wires as the bulb is rotated in the flame to keep the entire circumference at the same temperature.

Next take a round, soft pine stick with a conical point and begin to open up the mouth of the neck and roll a bead on it by rotating the neck in the gas flame and rubbing the plastic edge out and down with the wooden stick. This enlarging process is continued until the neck will take the desired size of cork or rubber stopper.

The flask is now complete and ready for use. If it is to be used for a washing bottle, a heavy rubber band or stout cord wound around the neck will make it much stronger in resisting the stopper pressure and more convenient to handle.

If the bulb is to be made into a boiling or a receiving flask, the bottom will not need to be flattened and the brass top may be removed and the throat enlarged to the proper size at once. If a heavy smooth lip is desired, it can be made by making a mold of some heat-resisting material, as shown in the drawings at the end of this article, and the lip turned down against it. This mold or form must be made in halves and clamped around the neck of the bulb. It must be warmed carefully before use, otherwise the glass will crack.

If a lipless flask is desired, the small end may be removed by placing a string saturated with kerosene around the neck and allowing it to burn away, then quickly plunging the neck into water up to the heated ring. This will cause the glass to contract and pop off at the line where it was heated. The broken edge is then smoothed by carefully grinding it down on a smooth grinding wheel and finishing it with a fine sharpening stone.

If a glass-tube cutter is available, the end of the neck can be removed without difficulty. This method is more reliable than the use of the kerosene string.

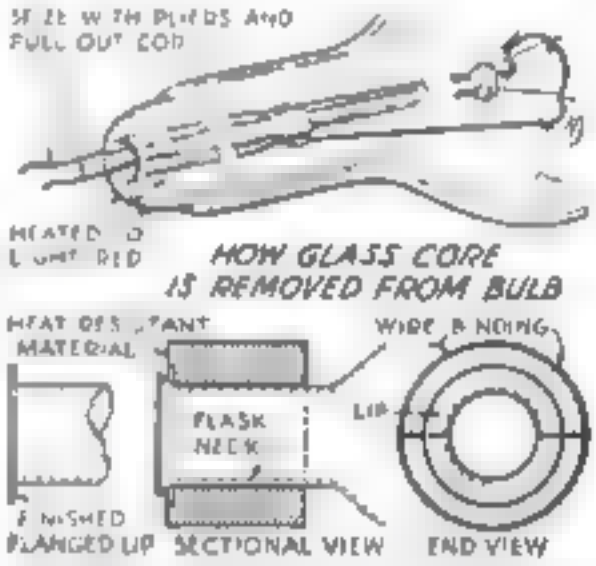
Long-necked flasks may be made by welding test tubes or necks from broken flasks to the necks of light bulbs. After a little practice this can be accomplished without difficulty. First be sure the ends to be joined are of the same diameter and fit all way around. This can be accomplished by grinding the ends on a smooth oilstone. Heat the ends carefully and evenly in the gas flame until plastic; then bring them into contact and exert a slight pressure.

FOR A DISTILLING flask, it will be necessary to weld a tube to the neck of one of the larger flasks at a downward angle of approximately 75 deg. to the neck. A hole is first made about halfway down the neck of the flask by heating the side of the neck to a red heat over the gas burner and then punching the hole from the inside by using a redhot wire with a right-angled hook on the end.

A piece of tube of the desired bore and length should be selected, and the free end heated sufficiently to smooth off the sharp edges. The end to be welded to the flask is next heated and flanged. This flange is turned out at a right angle to the tube and should extend about ⅛ in. all the way around it. The neck of the flask and the tube are next brought to a welding heat in the same flame; then the tube is carefully centered over the hole in the flask and the two gently pressed together. Very little pressure can be used or the flask will become distorted. The joint is now heated quite hot and the flange gently smoothed down to make the joint stronger and neater in appearance. In doing this, be careful to support both tube and flask or they will tend to sag out of shape.

AFTER the joint has been completed, the hot flask should be placed in a heated oven and allowed to cool very slowly. This will temper the glass and remove the strains set up in the welding operation. If all the flasks are given the hot-oven cure, they will be less liable to crack in use, especially when heated over a gas flame.

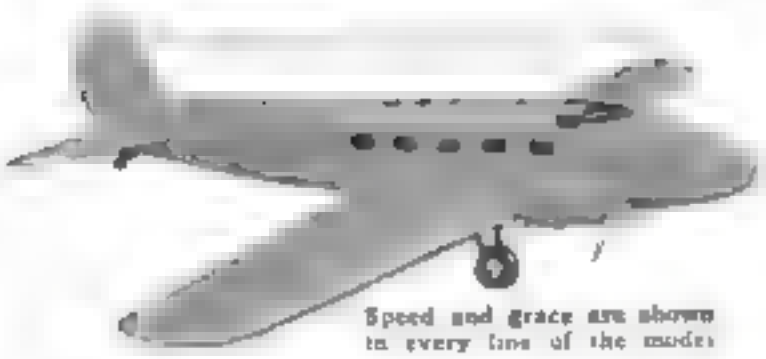
Sometimes the necks are cracked because of careless heating. If carefully cut off, the lower halves of such bulbs make transparent covers and shallow dishes.



HOW GLASS CORE IS REMOVED FROM BULB

SIMPLE MOLD FOR FLANGED FLASK LIPS

Method of drawing out the glass core and making a mold in two parts for flanged lips



Speed and grace are shown in every line of the model

SIMPLIFIED SCALE MODEL OF

Fastest American Transport Plane

By DONALD W. CLARK

THIS model of the Boeing Transport, the fastest type of passenger plane now in regular service, also happens to be the largest yet drawn up for this series with the exception of the *DO-X* flying boat. The scale of the model in comparison to the full-size plane is ½ in. equals 1 ft.

Some model builders may prefer to use balsa wood, but soft white pine is satisfactory. If necessary, two or more pieces can be glued together to get the right thickness. The model requires twenty-one pieces (or nineteen if the wing stubs or roots are not made separate).

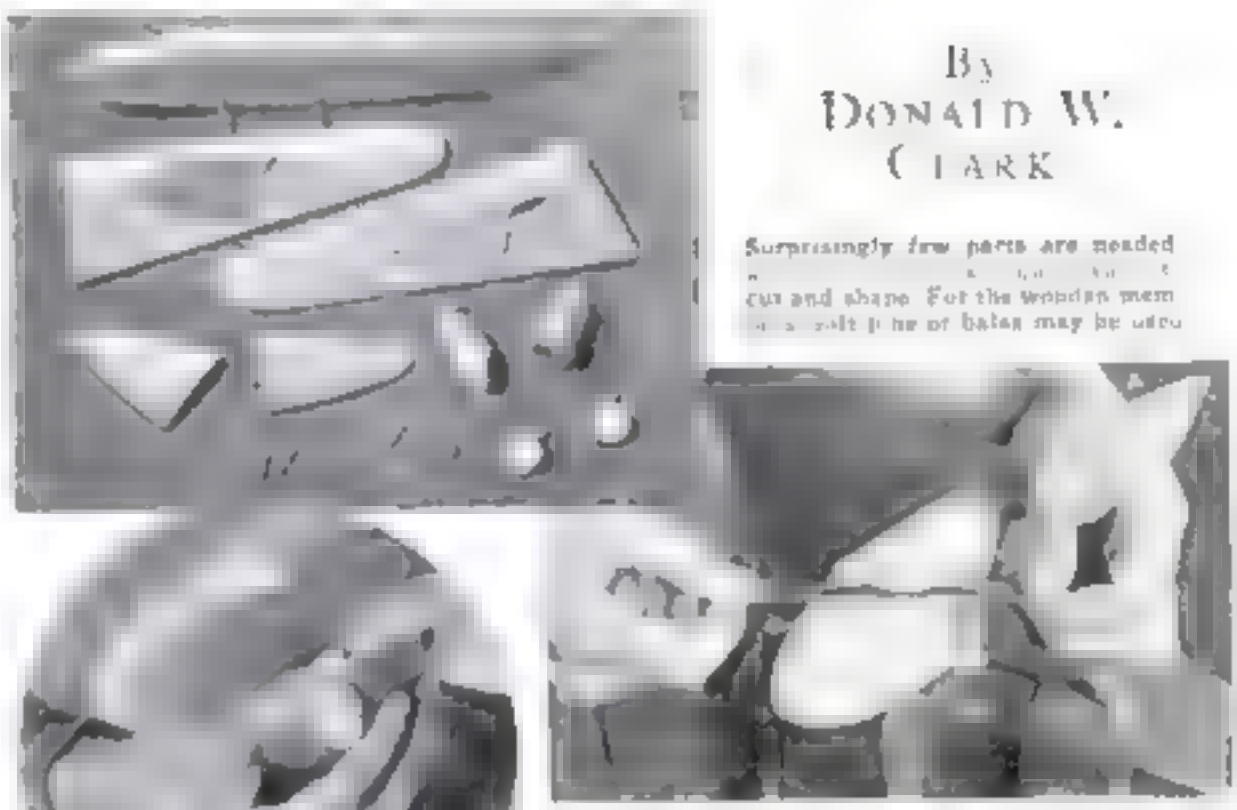
The fuselage should be sawed out in the usual manner and rounded to the proper shape. A hack-saw blade is handy for cutting the tail slot and cockpit windows.

Considerable planing is required to taper the 1 in. thick wings. On each end of the blanks, mark the wing section and plane down to these lines. Round the tips and sand the surfaces with medium sandpaper across the grain, then with fine sandpaper first across the grain and finally with the grain. Fasten the wings with 1/16 in. diameter brads or wire.

The vertical tail can be made of thin galvanized metal. The horizontal tail should be ⅛-in. wood, tapered as shown. Cut this blank long enough for both pieces, plane to shape, and then cut in two.

If no lathe is available to turn out the motor "eggs," make them of balsa wood. Fit them to the wing stubs and fasten with casein glue or household cement. The wheels can be of balsa also. The axles are 1/16 in. diameter soft wire and go through bottom holes in the struts, which are ⅛ in. metal. The propellers are 1/16-in. metal bent right-handed. The antenna is thread, the mast wire

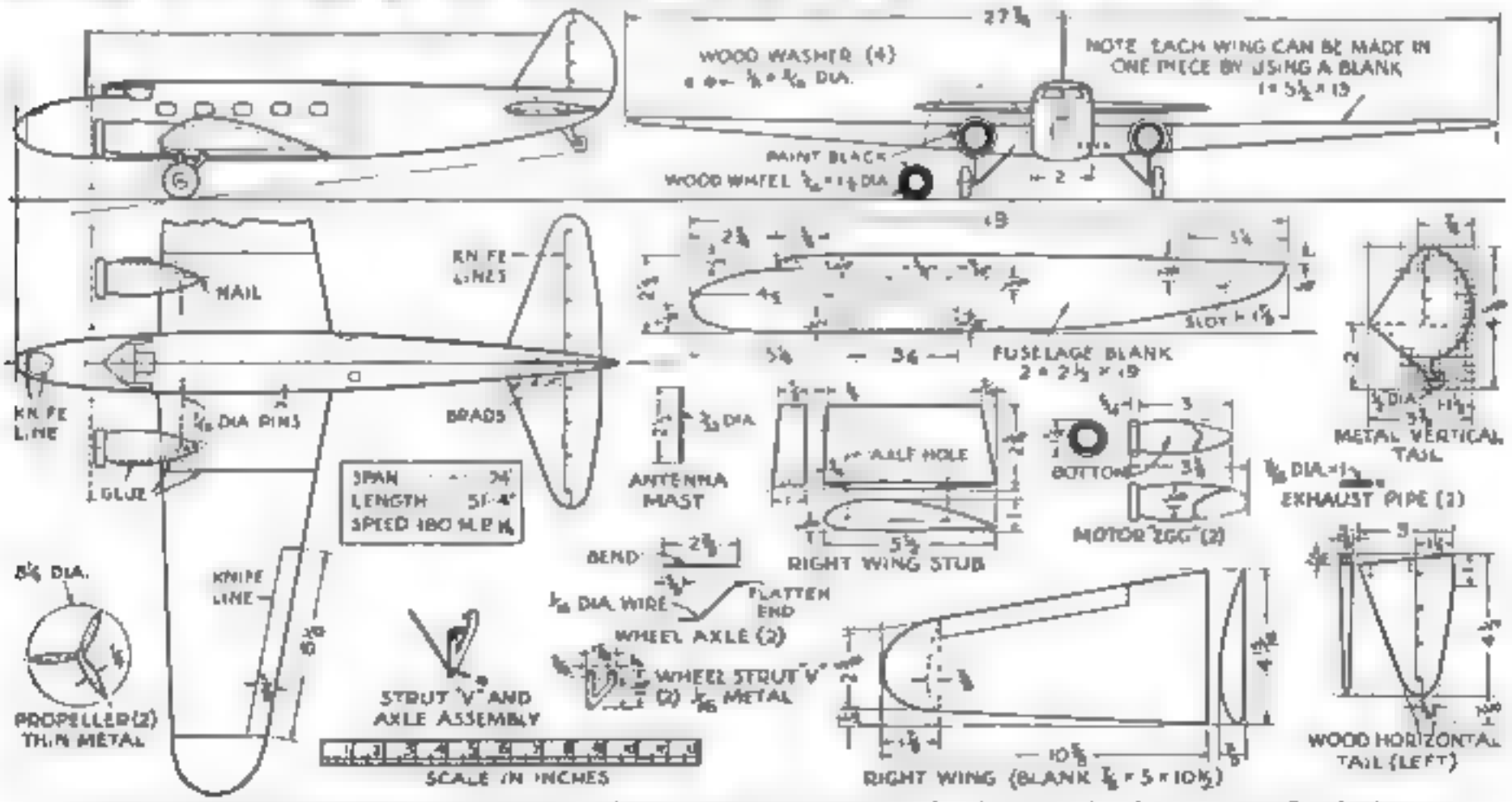
Surprisingly few parts are needed [illegible] cut and shape. For the wooden mem[illegible] soft pine or balsa may be used



After the fuselage block has been sawed out and [illegible] to the proper shape, the cockpit windows [illegible] are cut in with a hack-saw blade

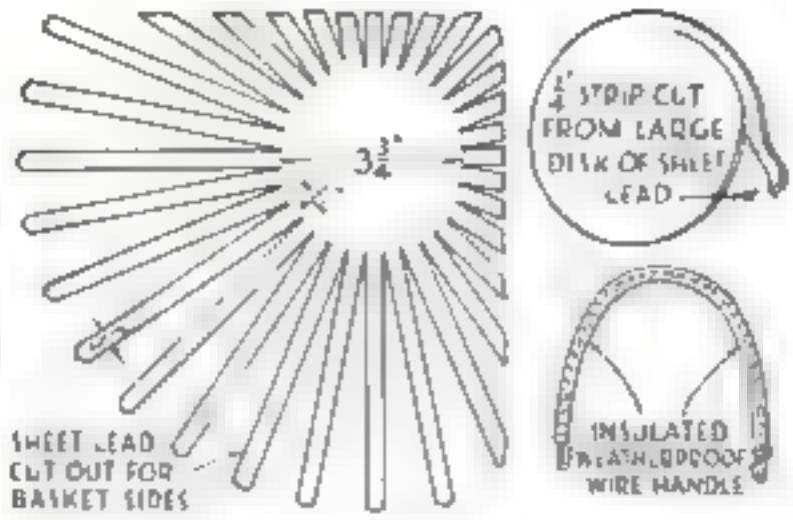
[illegible] the motor "eggs" to the wing [illegible] turned on a lathe, if one is available, or whittled from balsa wood

Paint the entire model flat white, followed with a coat of silver gray. Use black to represent the cockpit and cabin windows, tires, tail wheel, and grooves on the motor eggs



Assembly drawings of the model and details of the fuselage, wing stubs, wings, vertical and horizontal tail, motor "eggs," and other parts

FLOWER BASKET WOVEN FROM LEAD



Although it resembles a basket, this flowerpot holder is made from sheet lead. A disk of the lead is cut into a number of radial strips and a long, narrow strip is woven around them

THIS unique flower basket is made of sheet lead with no other tools than a pair of shears and your fingers. The lead should be about 1/16 in. thick. You can obtain it from your plumber, and in some of the larger cities it can be bought at department stores, now that craft work in sheet lead has become popular

A disk of lead 15 in. in diameter will cover a flowerpot 4 in. deep, 5½ in. in diameter at the top, and 3¾ in. at the bottom. If pots of other sizes are used, the drawings may still be followed provided an allowance is made for the difference in bottom diameter and the side strips are cut about one third longer than the height of the jar

Draw the outer circle (in this case 15 in. in diameter) on a sheet of the lead, and in the center of this scribe a circle 3¾ in. in diameter. Divide the latter into ¾-in. spaces and complete the layout, only a part of which is shown to save space. Then cut out the blank with a pair of shears. From another disk, cut a ¼-in. strip around and around until you have a piece about 12 ft. long.

Lay the basket blank on the table and bend every other strip straight up. Bend the ¼ in. wide strip around these at the bottom; then bend the remaining strips up, and the others out. Work around in this manner until the weaving is completed. The photograph shows how the top is treated. The handle is a 12-in. length of insulated weatherproof wire. Bare the ends and bend them around the top strand of the basket. Then wind a ¼-in. strip of lead around the wire.

If it is desired to have a saucer or tray inside the basket on which to set the flowerpot so that water will not leak out, make an allowance for this in drawing the layout.—DICK HUTCHINSON

ETCHING NAME PLATES

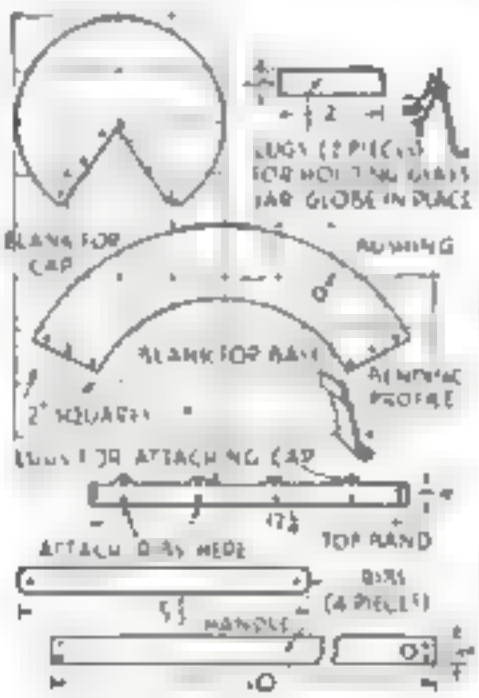
IF YOU have a rubber stamp for reproducing your name and address, you can use it for making novel copper or brass plates suitable for labeling boxes, luggage, models, and the like. Clean the stamp with soap and water until the rubber characters are free of ink and lint. Melt a small quantity of paraffin on a warm piece of scrap metal, press the rubber stamp against it, and quickly make an impression on the plate you wish to etch. This plate must be perfectly clean, and it should be slightly warm.

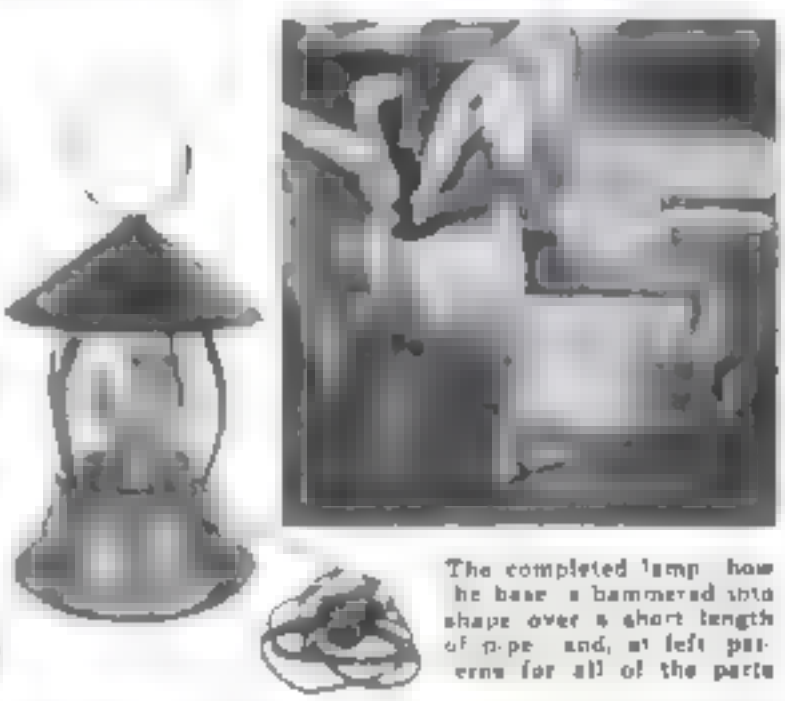
Place the plate in the etching solution, which can be made by mixing 1 part of concentrated nitric acid with about 8 parts of water. Let the acid act for a few minutes only, or just long enough to produce an even matte surface. Longer action usually results in the acid's working through the wax letters. Finally, wash the plate, scrape or melt off the wax, and mount.—JOHN C. WORKLEY

AMMONIA GIVES COPPER A DARK FINISH

ONE way of producing an antique finish on hammered copper work is to suspend it for several hours in a closed container having strong ammonia water at the bottom. A small fish bowl or fruit jar is suitable for most work. Clean the article well, removing every trace of grease from its surface. Then suspend it in the container so that it does not touch the ammonia water. The action of the fumes will cause the metal to turn dark and take on various shades of green, blue, and brown. Remove the article from the jar, polish with a cloth, and apply wax, lacquer, or whatever other finish you desire; or just leave the metal as it is.

SALAD JAR FORMS GLOBE OF LANTERN





The completed lamp, how the base is hammered into shape over a short length of pipe, and, at left, patterns for all of the parts

ALL pieces for this decorative lantern-type lamp are of 22-gage soft sheet copper except the handle, which is 18-gage. Each part is hammered on one side

Roll the base into a conical shape, and rivet the lapped joint with escutcheon pins. Place a short length of pipe in the vise, and hammer the base into shape as illustrated in one of the photographs. Expand the top to 3¾ in. in diameter, and roll up the bottom slightly. Then roll and rivet the top band, and rivet the four ribs to this. Shape the cap, drill four holes in it to match the lugs, and rivet the top band in place. Next rivet the ribs to the base. Shape the handle and rivet it on. After drilling holes through this and through the top of the cap, bolt the handle in place.

Take a quart salad-dressing jar and drill a ¾-in. hole through the center of cap. Attach a light socket so that it will come on the inside of the jar. Wire with a drop cord. Place the cap on the jar and insert the jar in the lamp upside down. Then rivet in the lugs to hold the jar in place. Run the cord out through a fiber bushing.—R. C. FRASER

Jig-Sawing Trick Gives Carved Effect to Plaques and Panels

By a very simple jig-sawing process it is possible to give the effect of low relief carving to wooden panels or wall plaques. The one shown below is an "antique" wall plaque, but it would be equally suitable for a photograph album or scrapbook cover. The relief is obtained by setting the saw table at such an angle that the floral parts, when reinserted in the holes, are raised about 1/16 in. above the background, with the petals of the blossoms rising successively 1/16 in. higher.

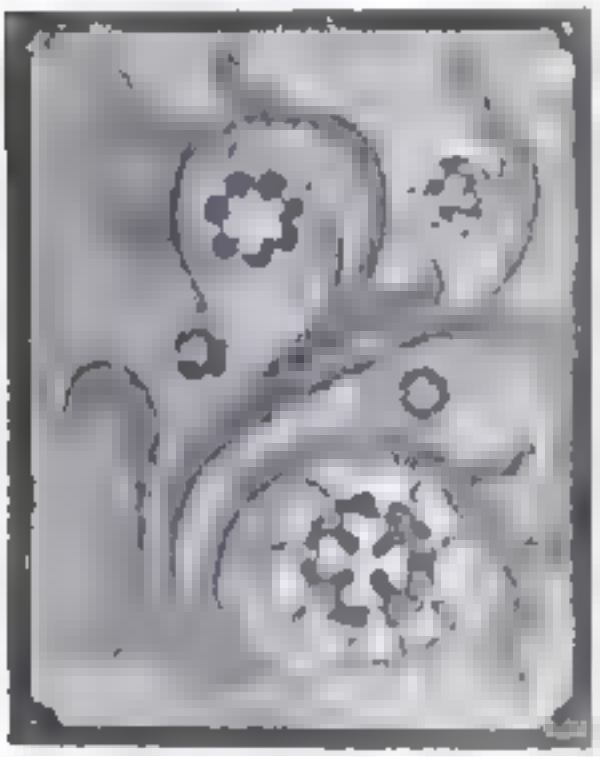
Three-ply pine veneer ¼ in. thick is suitable stock for the plaque. Sand the face smooth, coat it with thin glue size, and resand after drying. Then prepare a paper pattern by sketching the design through 2-in. squares, and transfer the outline to the wood. The piece is now ready for the saw, but first try the bevel on scraps of wood.

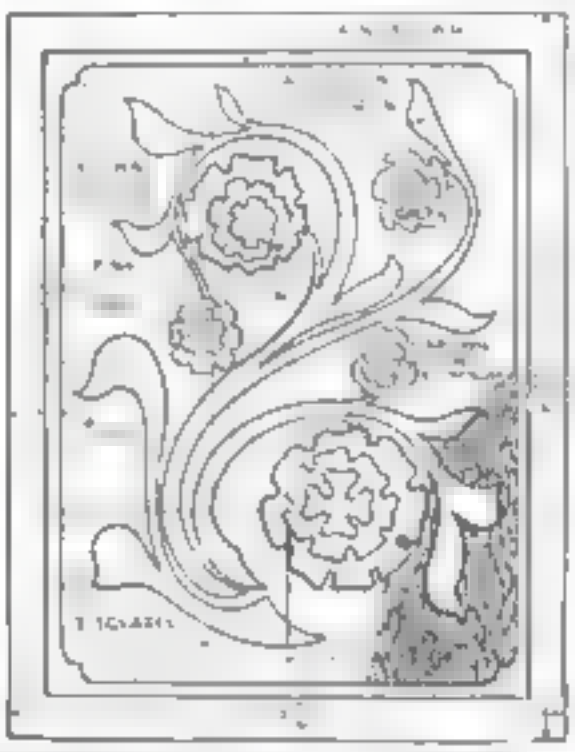
Coat the top of each part with boiled linseed oil, and beginning with the flowers, coat the joining edges with some slow-setting glue, such as casein. If the assemblying is done quickly, the parts can be pressed up into position with the fingers. However, if the glue stiffens too much, paste strips of cardboard on the background, turn the plaque face downward on the bench, and drive the relief parts from the back, using a hardwood stick for a punch.

When the glue is hard, peel off the cardboard and glue. The piece can be painted immediately, but a much more attractive effect is obtained if the background is surfaced by working over it with light gouge cuts, or stippling it with a woodcarver's punch.

Gild the background at the left, but use aluminum paint at the top and right. When dry, paint small sections at a time with a mixture of dry burnt umber mixed with four-hour (quick-drying) varnish. Wipe this off across

The parts are cut on a jig saw with its table tilted. When they are replaced in the background, they are pressed up to project slightly





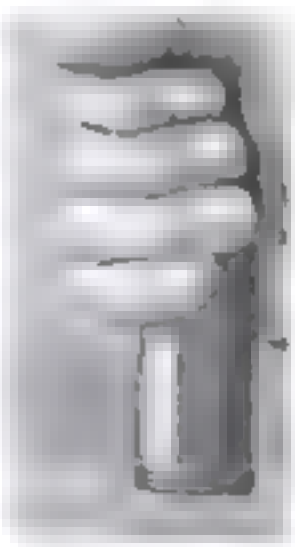
The finished wall plaque, which appears to be skillfully carved, and the pattern drawing

grain with a cloth, so as to leave the points bright and the depressions dimmed with brown. Allow some of this to smudge the edges of flowers, leaves, and stems.

Next put in the other colors, having the paint rather thin. In a few minutes the color will blend with the brown smears in a granular stipple at the edges, giving a delightful antique effect.

If the piece is to be used for an album cover, drill holes along the left edge through which to thread the lacing, and protect from handling with two coats of dull varnish.—Edwin M. Love.

A PAD FOR HANDLE OF HAMMER

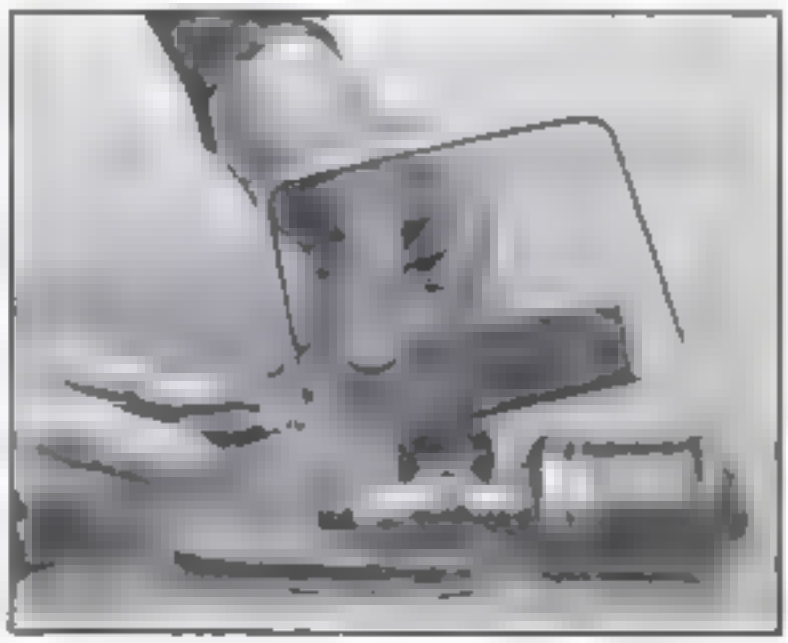


Hammer handle with rubber pad for tapping softwood parts

The handle end of the common household claw hammer is often used for knocking or tapping window screens, storm sash, and many pieces of work which would be marred if hit with the head of the hammer. Even so, the hickory handle is quite hard enough to dent softwoods. It is better to pad the end with a piece of fairly thick but soft tire casing. Trim it to fit and tack it on with several fairly long brads or thin nails, set well below the face of the rubber. This is also useful for temporarily holding things in place with the end of the handles, especially when working on a ladder or scaffold.—F. B.

SAWLIKE POLISHER GETS INTO GROOVES

When cleaning and polishing small round parts, it is difficult to get down into grooves with the emery cloth. Most of the makeshift devices used for holding the cloth have no suitable handle or grip, but one can be made for this purpose from a common coping-saw frame. Fasten a piece of wire at each end so that it will slip into the slots of the frame just like a saw blade. Then wrap the wire with heavy cord, tying the ends to the frame. Bend a narrow strip of emery cloth over the cord and use the tool for polishing the grooves. If still smaller grooves must be cleaned out, leave the cord off.—B. W.

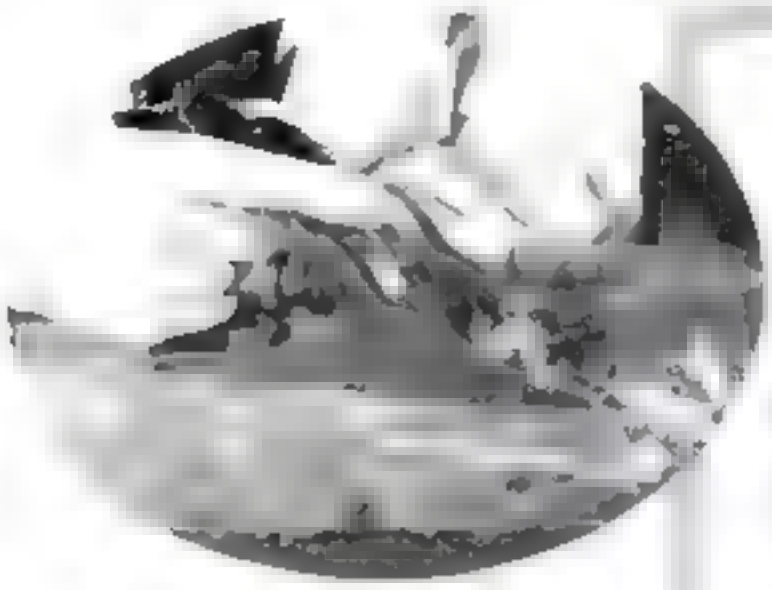


A wire is flattened at the ends, placed in a coping saw frame, wrapped with cord, and covered with emery cloth

MODEL MILK CANS

Realistic little milk cans for use on a model railway can be made by cutting off the top part of a number of ordinary wooden clothespins. Make the cut square so the "cans" will stand firmly. Finish them with a coat of aluminum paint, followed, when dry, with varnish.—James Eckel.

Short Cuts I Use in Making



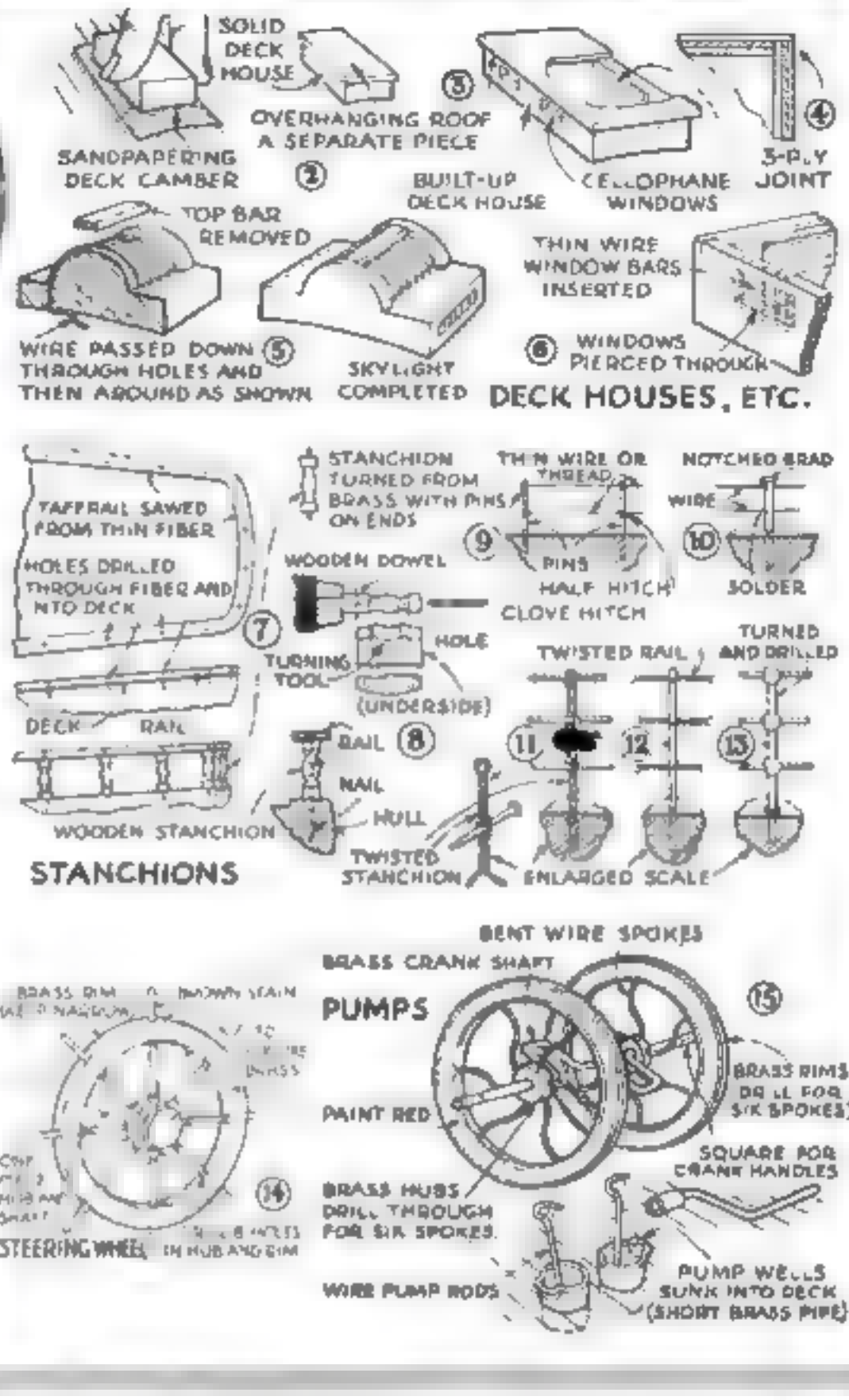
Masts and spars can be turned but it is quicker as a rule to shape them with a fine-set plane and finish with sandpaper. Straight-grained wood must be selected

CHIEF among the joys of model making is to think out the best technique for constructing each part and then watch it develop into a craftsmanlike, well-finished product. I frequently spend as long in deciding on the most suitable material and method of working it as in doing the job. Nevertheless, I am always ready to try a technique someone else has found useful, and, as you no doubt have the same attitude toward model making, I shall try to give you the benefit of my experience in the making of the more frequently required fittings for ship models. Please remember however, that I pretend no perfection or infallibility. If you know of better methods, go to it!

A ship model, in addition to a correctly shaped hull, requires certain small parts for the deck and rigging. These vary with every type of vessel, period, and nationality. Whatever the vessel, the making of each little part will be more easily accomplished by employing the right methods. Most of the processes to be described in this and a following article can be improved and expedited by the use of motorized tools. Those who have these will know how to use them. Here, as far as possible, only hand-tool methods are given.

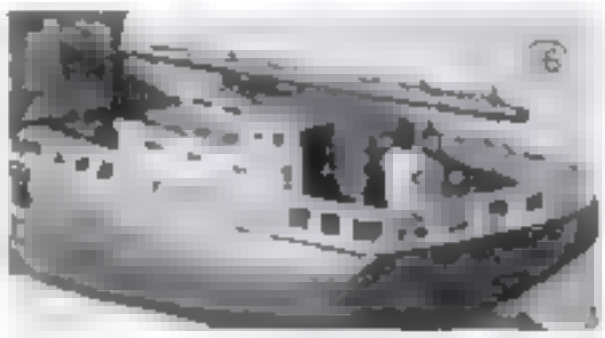
Deck Houses. Deck houses, skylights, and the like are usually made of solid blocks of wood. Finish the sides with a flat file which will give a flatter surface than sandpaper. If the roof projects, make it a separate piece. If the deck is cambered, lay a piece of sandpaper on it, then rub the house on the sandpaper until it fits (Fig. 2).

Large deck houses can be built up, the windows being pierced and backed with cellophane (Fig. 3). Thin three-ply is good for this. With it neat strong corners can be made, two plys being rabbeted away from the front and back pieces to take the sidepieces (Fig. 4). Bars can be put across the windows by boring down from the top and inserting thin wires (Fig. 5). With circularly topped skylights, cut away the top bar, bore down through the skylight and wind wire around. Then replace the top bar as shown in Fig. 5.



A variety of ways to make deck houses and stanchions, and a typical steering wheel and pump. Keep the fittings in scale with the model and see that they are uniform

Stanchions. Taffrails around the stern are somewhat tricky to fit. They can be made from chair-caning spline, hard rubber, or celluloid, steamed and bent to shape, but are better made from thin fiber board cut to shape (Fig. 7). In either case, lay it on the poop edge and bore through for the stanchions (posts). These stanchions are best turned to shape from square brass stock with points above and below to stick in the upper and lower rails. Two or three beads on a ⅛-in. pin will, however, serve fairly well. Wooden stanchions (Fig. 16) may be turned with a homemade form tool such as that illustrated in Fig. 8.



A fiber taffrail supported by wooden stanchions. A rail passes through each stanchion

For the stanchions of iron-bar railings I have found no entirely satisfactory substitute for those turned from brass rod

Ship Model Fittings

Captain* E. ARMITAGE McCANN *gives details of masts, yards, pumps, and various small parts

Very small spars can be planed by holding the plane face up between the knees and drawing the spar over it

and drilled (Fig. 13). These require a precision lathe and well-made boring jig.

The simplest substitute is to drive in ⅛-in. pins and hitch two or more plain threads along them, with clove hitches at the ends and half hitches between (Fig. 9). Richard H. Mohr, a reader, suggests using two threads twisted together between stanchions (Fig. 12). Either way, a drop of cement put on at the junctions with a sharp point will hold the thread or wire and form a sufficient bait.

Another model maker, L. Troup, sends us the idea that, especially for navy-type stanchions, No. 20 wire brads from ⅜ to ½ in. long are good (Fig. 10). He files two or three nicks in each, inside or outside as required, and sets the wires in these, aligning them very carefully.

Where one can find arm support at the ends the neatest substitute is to take two bights of very small wire (30 or 32 gage), bend them over a stiff small wire or a needle, twist together, then carry them around another wire, twist together and so on until one has a twisted rod with the necessary number of holes through it (Fig. 11).

Steering Wheels. A real steering wheel of the best type has an iron hub with a brass cap. From the hub project eight or ten curved hardwood spokes into which are mortised the sectors of the hardwood rim. The rim is strengthened with brass faceplates, before and abaft.

The most primitive wheel, which one can use on a very small model only, is the sprocket wheel of a watch. Small wheels can be cut from sheet celluloid or brass.

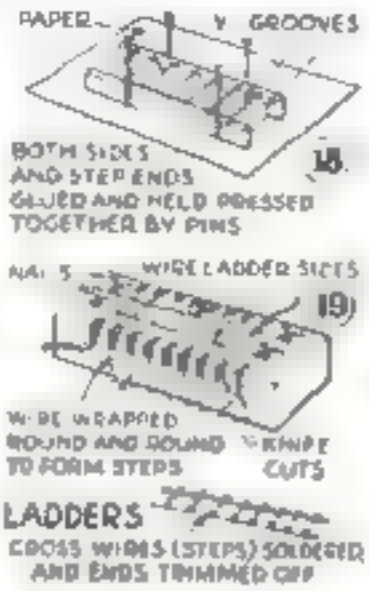
To make a good wheel (Fig. 14), one must turn or file a hub and axle in one. I drill part way through for the spokes, then make a brass rim, also bored, and turn the spokes, which are made to fit tightly in the rim and hub holes. The wheel should hold together without solder, but for safety either hot or liquid solder may be used. Most model steering wheels have their rims far too thick. A real rim (Fig. 22) is little, if any thicker than the spokes at the widest, say from 3 to 4 in., with grips about 2¼ in. diameter at actual size. However made the spokes and rim edges should be finished to imitate teak, and the faces to look like brass.

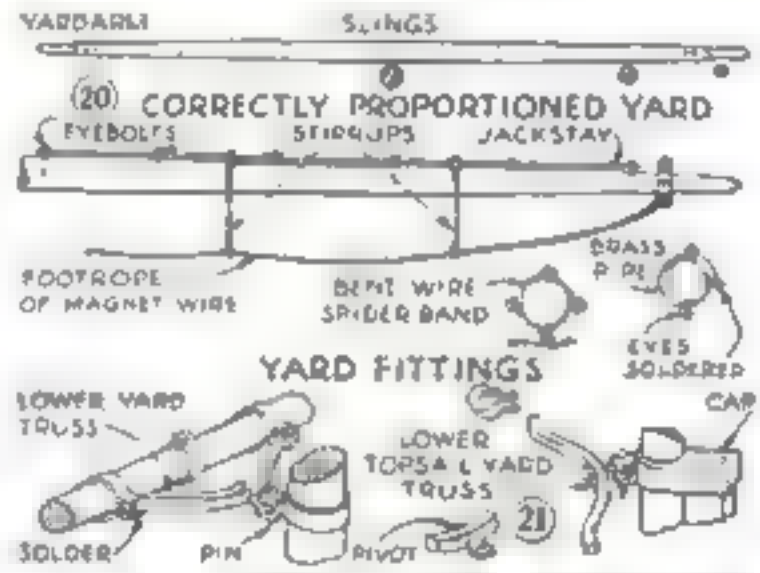
Pumps. The wooden merchant ship was to have the pumps on the gun deck worked with long pump brakes or handles. On merchant ships the outlets were, of course, on the main deck just abaft the mainmast. Since the 1850's, all the latest cranks with handles and flywheels have taken the place of the brakes.

The crank shaft rests on the bfe rails (Fig. 25). The flywheels are almost invariably inside the pumps and the handles, of course, outside. The rims of the wheels are about 4 ft. diameter, 4 in. thick, and oval shaped in section and the spokes are usually curved. To make one (Fig. 15), cut or turn the rim from sheet brass, or bend and solder it from brass rod. Drill this for six spokes. Bore a brass hub right through for the spokes. With soft wire, thread the spokes in position and solder to the hub, leaving some extra length projecting at the rim. Bore for and solder in the crank shaft, hold this in a vise and turn the rim clockwise about 30 deg. Then, with round nose pliers, regulate the curves of the spokes. Cut off the projecting ends and solder.

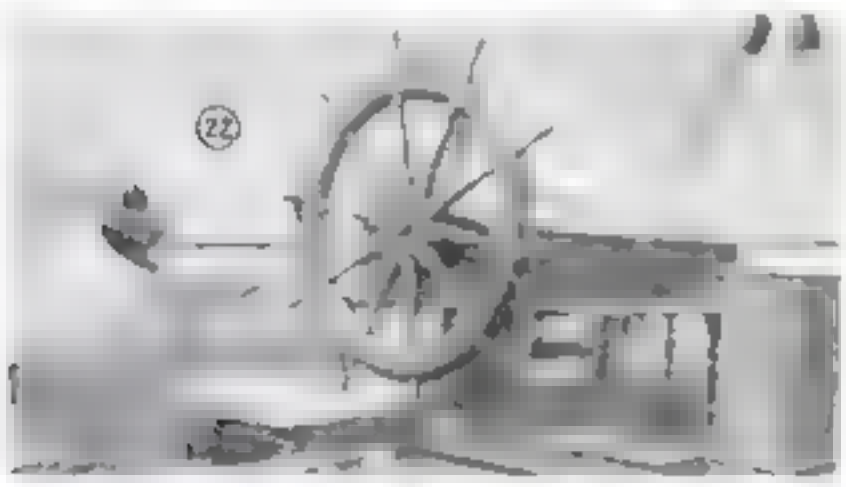
There are usually two pump wells, the ends of which are about 9 in. in diameter, oval or round. They project about a foot above the deck, usually with spouts pointing outboard. Pieces of brass tube sunk in the deck will serve for these.

The cranks above these are about 6 in. off center, giving a 12 in. throw. The handles are about 18 in. vertically by 36 in. horizontally. These fit on the ends of the crank. *(Continued on page 84)*





Methods of making wooden and wire ladders, a correctly proportioned yard, and the principal fittings used on yards



When making steering wheels and pumps it is well to know what real ones look like. Most models steering wheels have too thick rims. Pumps are usually set inside the pinrails

An expert whose camera has always paid him rich dividends tells you how to make high-grade magazine illustrations—Backgrounds and lighting for close-ups—Methods of adding human interest

By
Frederick D. Ryder, Jr.

THE TRICKS OF TAKING Saleable Photos IN YOUR HOME WORKSHOP

HAVE you ever sent a contribution to the Home Workshop Department of POPULAR SCIENCE MONTHLY showing how to make some new and useful article or, perhaps explaining a novel way to do some common home workshop job? If you have you probably found illustrating your manuscript the chief difficulty.

The editor tells me he is regretfully compelled to return many otherwise excellent contributions because the photographs accompanying them are so poor that they could not possibly be reproduced in the magazine. He has, therefore, suggested that advice on how to take good pictures of the things you build in your home workshop would prove especially useful to prospective contributors and to all others who wish to make similar record pictures.

The ideal picture from the magazine editor's viewpoint is 8 by 10 in. in size. Prints 5 by 7 in. are acceptable, but prints smaller than 4 by 5 in. needlessly handicap the sale of your article. All prints should be on glossy paper. They should show exactly the points you want to illustrate. All important details should be clear-cut and knife-sharp. Most important of all, the pictures should include at least one of the human-interest type, that is, include a human figure or at least the hands.

Don't let the size requirement worry you. Any really sharp, small negative will give satisfactory enlargements up to 8 by 10 in. If you have no enlarging equipment of your own, you can have large prints made at small expense. If you don't wish to take a chance on this additional cost, inclose the small negatives in an envelope and send them in with your article. Then, if the editor accepts it, he can have suitable enlargements made.

Getting clear-cut, sharp pictures of home workshop subjects is easy enough, but the technique is not quite the same as in taking the ordinary snapshots to which you probably are accustomed. In the first place several of the pictures should be close-ups. You can't stand 6 ft. away and have the resulting picture show, for example, a novel detail in the rigging of a ship model or exactly how the sections of a wooden piece are fitted together. In order to take close-up pictures, you must have a

$50 in Prizes *for* Indoor Photos

ANY SUBJECT . . . ANY SIZE

Here's a new photo contest in which you have as good a chance to win a prize as anyone else. The only thing that counts is the quality and general interest of the picture itself. There are no restrictions or conditions except that the photos must be taken indoors by an amateur. The developing and printing, however, can be done by a professional.

The prizes are as follows:

FIRST PRIZE	$25
SECOND PRIZE	15
THIRD PRIZE	5
FIVE PRIZES, $1 each	5
TOTAL	$50

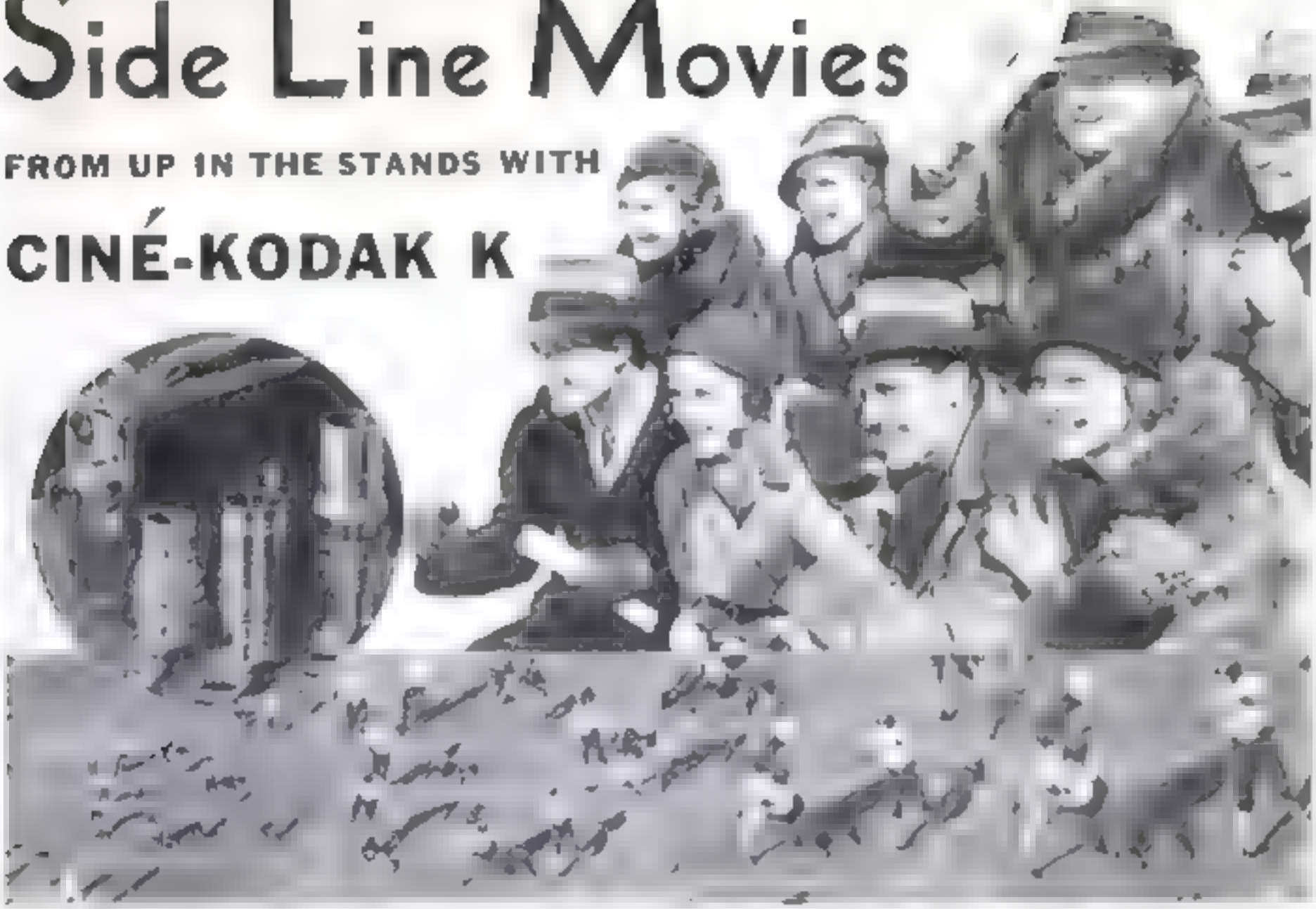
You may enter as many different prints as you please. Mail them to the Photographic Department, POPULAR SCIENCE MONTHLY, 381 Fourth Avenue, New York, not later than December 1, 1933, and mark your entry "November Photo Contest." It is not necessary to send the films. No prints will be returned unless a self-addressed, stamped envelope is inclosed. The contest is open to all but employees of POPULAR SCIENCE MONTHLY and their families. In case of ties, each tying contestant will be awarded the prize tied for.

Indoor photos are required because the contest is intended to encourage readers to make photography one of their winter hobbies. With the new lights and supersensative films now available, you can take better pictures indoors than outdoors and have much more fun doing it.

Side Line Movies

FROM UP IN THE STANDS WITH

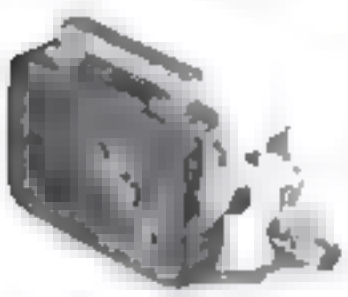
CINÉ-KODAK K



With Regular f.1.9 Lens | With 2-inch f.1.5 Lens | With 3-inch f.4.5 Telephoto | With 4½-inch f.4.5 Telephoto

HERE'S THE SAME PLAY as it looks to a Ciné-Kodak K through four of its interchangeable lenses. This camera can see the game better than the spectators from any place in the stadium. Slip a telephoto lens on the Ciné-Kodak K and it lifts you from the top row of seats out on to the field—lets you make close-ups of the play, check the referee's close decisions, record the high-spots of the game in a fast-moving, thrilling newsreel of your own.

Equipped with an *f*.1.9 lens, which permits you to make movies in black-and-white or full color, indoors or out, Ciné-Kodak K costs $150. Five supplementary lenses, $48 to $55.



MOVIES FOR 10 CENTS A SHOT

Most versatile of the famous "Eights," Ciné-Kodak Eight, Model 60, makes movies indoors or out, focuses sharp from 2½ feet to infinity, can make telephoto shots. gets 50 to 70 scenes on a $1.25 roll of film. With *f*.1.9 lens, carrying case, $79.50. Telephoto lens, $37.50.

A FAST FILM FOR MOVIES OR STILLS

Eastman's new super sensitive panchromatic films are the favorites of Hollywood studios, news-reel cameramen and portrait photographers the country over , and are now available to amateurs as well. Professionals choose these films for their extreme speed, full color-sensitivity, and long tone scale. You'll find wide use for them in the poor light of late fall days and for indoor snapshots at night. In 16 mm. size for movie cameras and in rolls and packs for all ordinary sizes of still cameras. Ask your dealer for Kodak or Ciné-Kodak Super Sensitive Panchromatic Film.

. . for fast action "still" shots

THREE EXCELLENT KODARS for action pictures. All have *f*.4.5 Kodak Anastigmat lenses—reserve lens power which permits you to maintain high shutter speeds early or late in the day — to make indoor snapshots day or night with the low-cost Kodaflector and the new Kodak Super Sensitive "Pan" Film.

LEFT: Kodak Recomar, with 8-speed Compur shutter, double bellows, ground-glass back, and eye-level finder, 2¼ x 2¼, $46; 2½ x 3½, $50.

CENTER Vest Pocket Kodak Special, with 4-speed Dianastic shutter, for 1¾ x 2½ pictures, $15.

RIGHT: Kodak Six-16, with 4-speed Diodak shutter, for 2½ x 4½ pictures, $30. Kodak Six-20, 2½ x 3½, $28.

If it isn't an Eastman, it isn't a Kodak

THESE FREE BOOKLETS will tell you more about the five cameras shown here and about many other new types of movie and still picture-making equipment. Just check the booklets you want and mail the coupon today to the Eastman Kodak Company, Rochester, N. Y.

- ☐ 16 mm. Ciné-Kodaks and Kodascopes
- ☐ Kodak General Catalog
- ☐ Home Movies with the Ciné-Kodak Eight
- ☐ Picture Taking at Night

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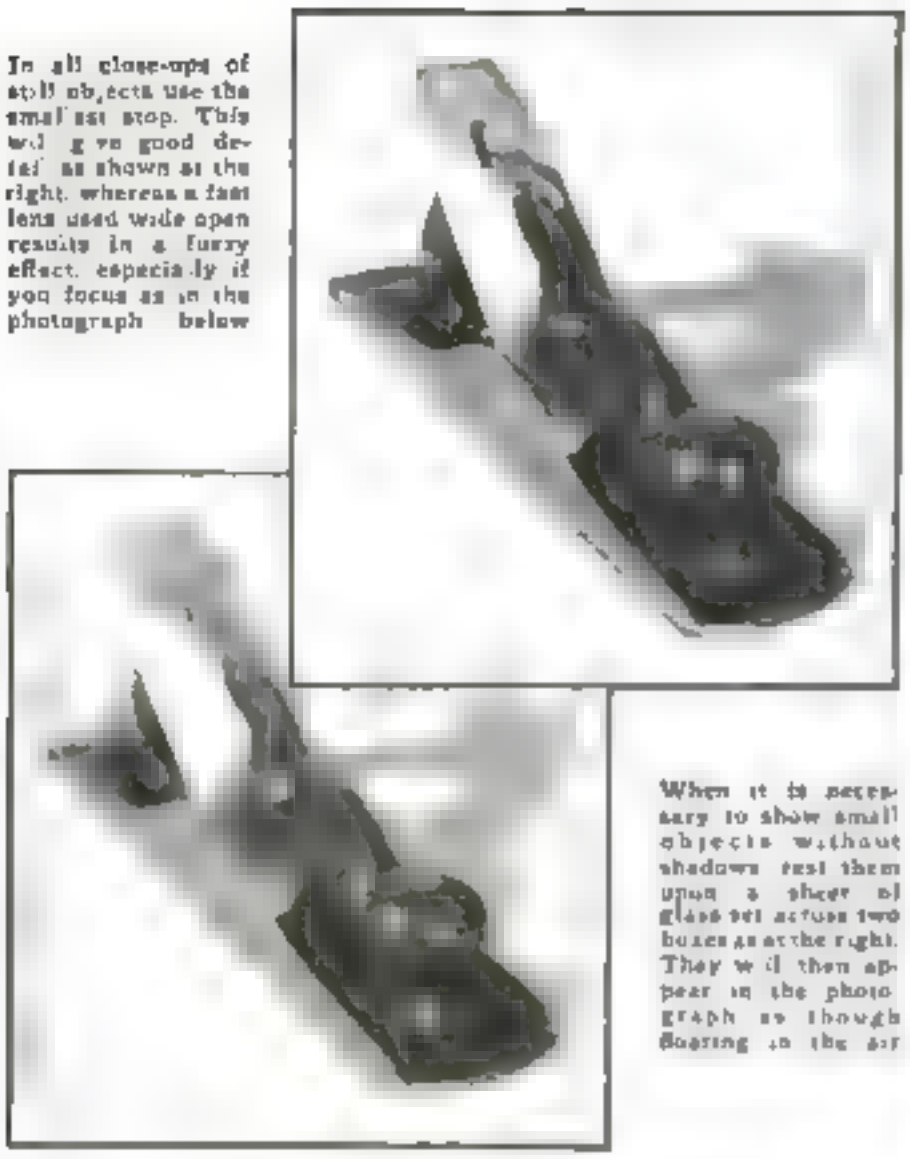


In all close-ups of still objects use the smallest stop. This will give good detail as shown at the right, whereas a fast lens used wide open results in a furry effect, especially if you focus as in the photograph below

When it is necessary to show small objects without shadows rest them upon a sheet of glass set across two boxes as at the right. They will then appear in the photograph as though floating in the air

camera with a double extension bellows and it should have a ground-glass back for accurate focusing. An expensive, high-speed anastigmat lens is not a necessity nor need the camera itself be an elaborate and costly type.

The second requirement is a good tripod fitted with a tiptop. (P. S. M., July '33, p. 74.) The tripod is necessary because virtually every shop picture should be a time exposure. The tiptop is needed to allow you to point the camera down to get the desired view of many subjects.

The choice of a suitable background and careful lighting are of supreme importance. Using the wrong kind of a background will make a dismal failure out of the most carefully taken picture. The function of the background is to set off the object being photographed to the best advantage. Generally speaking, the background should be as plain as possible, and extreme contrast should be avoided. Do not, for instance, photograph a black or very dark object against a dead white background. The long exposure needed to register the dark object on the plate or film will result in severe overexposure of the background, and there will be an undesirable softening of the sharp outlines of the subject owing to the spreading of light within the surface of the film. Ordinary brown wrapping paper makes an excellent background for all very dark objects, and is equally good for white ones.

Never attempt to use wrapping paper that has already been used for wrapping parcels. The wrinkles and creases photograph into a multitude of distracting lines that spoil the attractiveness of the picture. It will pay you to go to a store and get a fresh piece right off the roll—and roll it up instead of folding it to take it home.

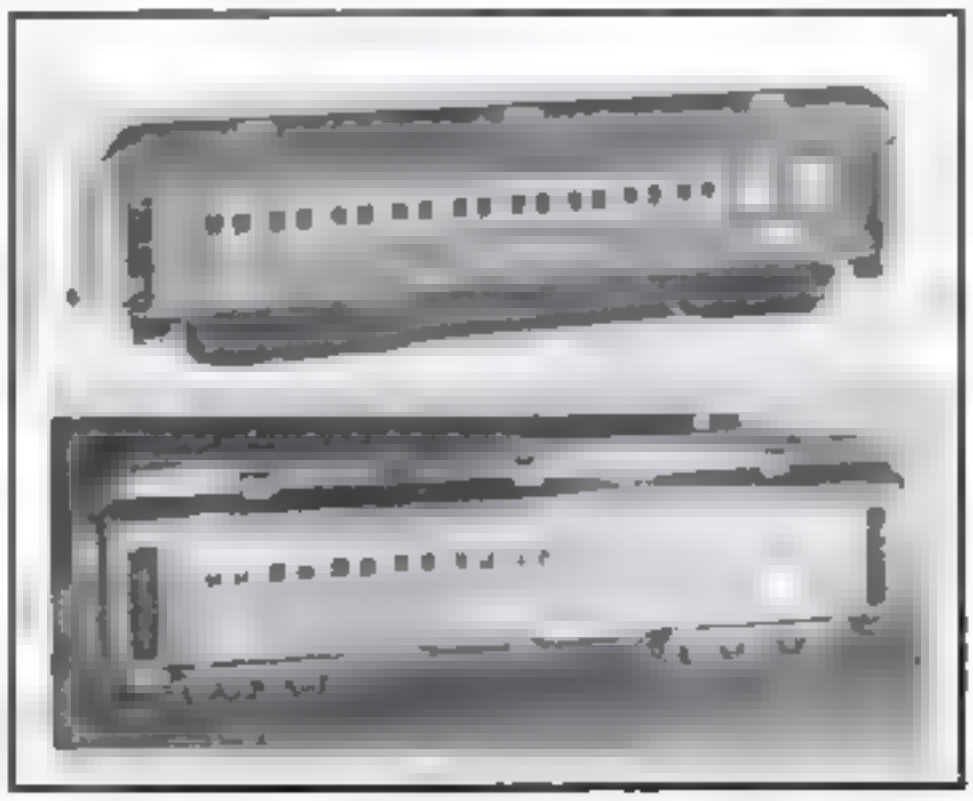
On many subjects it is desirable to have the background show no lines at all. This is an easy trick. The illustration at the beginning of this article shows how this is done. The paper is laid on the table and the back edge is swung up in an easy curve over a couple of sticks tied to the back of a chair.

Another trick that is especially valuable when you want to show small objects without shadows, as though they were floating in air is to use a sheet of window glass as shown in the right-hand illustration above. If the lights are correctly placed, the shadows will strike the background outside the picture angle. It is possible, if you have no tiptop, to use this same method with the sheet of glass placed vertically and the objects cemented to it, although it is a lot more trouble to do it that way.

The simplest method of lighting any home workshop picture is to use a couple of photoflood bulbs in reflectors. In adjusting the lights, remember that one side of the subject should receive a little more light than the other so that the shading will make the object stand out and not look as though it had only two dimensions. Inky black shadows should be avoided wherever possible. The appearance of the subject as you look at it from in front of the lens is a good guide if you keep in mind that the camera ordinarily will exaggerate the shading to some extent.

A word of caution in setting the lights—look out for reflections from shiny surfaces! This is especially important in the case of bright metal pieces or of wooden objects that have been varnished or enameled. It often is impossible to avoid all reflections, but you usually can keep the reflections away from the large surfaces and restrict them to a few shiny spots. The photographs of the model railroad car show what I mean. The upper one was taken with the same brown-paper set-up shown on page 68. The car itself is painted with dark green enamel, and the lights were placed off at

(Continued on page 89)



These views were photographed with the same general set-up shown on page 68. The difference is due to changing positions of the lights

TAKE PICTURES *'round Home or Workshop with the New* G-E MAZDA PHOTOFLASH LAMP

only 15c

Ask your druggist or camera dealer about this magic new picture-taking lamp. Better still, get some lamps and learn how they make *indoor* pictures as easy to take as snap-shots in sunlight. Now only 15 cents. General Electric Co., Nela Park, Cleveland, O.

GENERAL ELECTRIC

MAZDA PHOTOFLASH LAMPS

New this month . . .

A Butterfly Table

CONSTRUCTION KIT

NO. 6 Table

IF YOU are looking for something to make for Christmas, you could not find a more generally useful, a more durable, and a more distinctive gift than the new butterfly table that is offered this month by the Popular Science Homecraft Guild in the form of an inexpensive construction kit. It is a substantial little table in solid rock maple that will grace any room. Two of the accompanying illustrations clearly show the unusual and beautiful design of the butterflies, the carefully studied shape of the top, which varies slightly from the ordinary oval, the fine proportions of the turned legs, and the general impression of simplicity and refinement. It has all the earmarks of custom-built furniture and is the sort of piece that is likely to become a family heirloom.

The kit contains all the parts perfectly machined and ready for assembly. Your work will be mainly in softening and rounding all sharp edges, gluing the whole together (all the joints are correctly cut and bored for dowels, and the dowels, screws, and hinges furnished) and applying the finish. Instructions for finishing and the necessary stains are included, but not the finishes themselves.

This new piece is No. 6 in the accompanying list, which also shows all our other kits that are still available. Each kit is accompanied by instructions or blueprints.

A. Whaling ship model *Wanderer*. All the raw materials—wood, wire, fishing line, chain, celluloid, and everything but the paints, together with Blueprints Nos. 151, 152, 153 and 154 and a booklet. The hull is 20½ in. long . . . $6.90

AA. Same with hull lifts sawed carefully to shape . . . 7.40

D. Spanish galleon ship model, 24 in. long. All the raw materials (except paints), Blueprints Nos. 46 and 47 and a booklet . . . 6.45

DD. Same with the two main hull blocks shaped . . . 6.95

E. Battleship model, *U.S.S. Texas*, 3 ft. long. All the raw materials (except paints) and Blueprints Nos. 197 to 200. . . . 6.95

EE. Same with hull lifts sawed . . . 7.45

F. Liner *Manhattan*. All raw materials (except paints) for a simplified miniature model 12 in. long and Blueprint No. 204 . . . 1.00

G. Elizabethan galleon *Revenge*. All raw materials (except paints) for a model 25 in. long and Blueprints Nos. 206 to 209 . . . 6.75

GG. Same with hull blocks shaped . . . 7.75

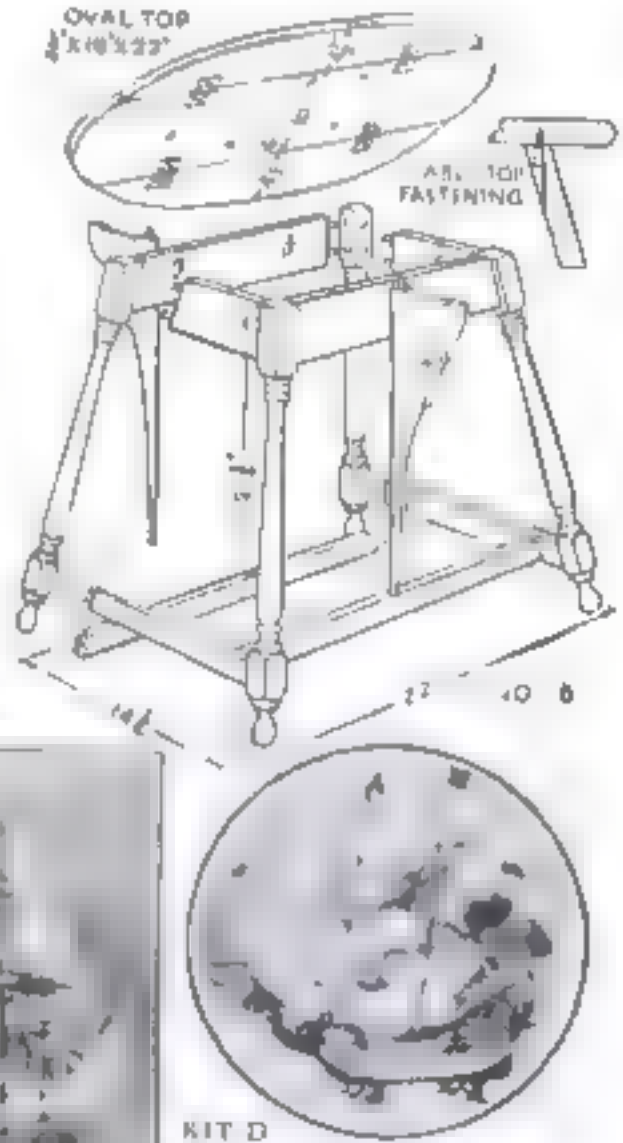
H. Cruiser U.S.S. *Indianapolis*. All raw materials (with enamels) for a simplified 15 in. model and Blueprint No. 216 . . . 5.50

No. 2. Solid mahogany tray top table 24 in. high with a 15 in. diameter top. Ready to assemble . . . 5.90

No. 4. Solid mahogany book trough 42½ in. long, 9 in. wide, and 42 in. high over all. Ready to assemble . . . 5.50

No. 5. Solid rock maple hanging wall rack with one drawer 19½ in. wide, 33¼ in. high. Ready to assemble . . . 5.75

No. 6. Solid rock maple butterfly table top 19 by 24 in., height 27½ in. Ready to assemble . . . 6.90

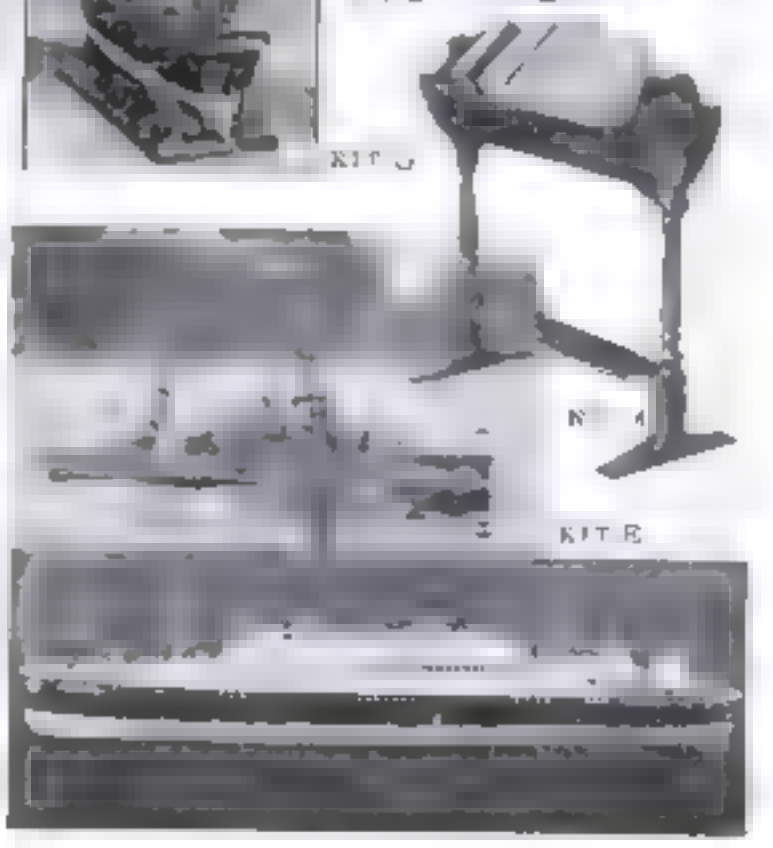


KIT H

NO. 5

NO. 2

KIT A



KIT F—Materials for 12-in. model of *Manhattan*

Popular Science Homecraft Guild,
261 Fourth Avenue, New York, N. Y.

Please send me kit . . . for which I inclose $. . . (or send C. O. D. ☐)

Name . . .

Address . . .

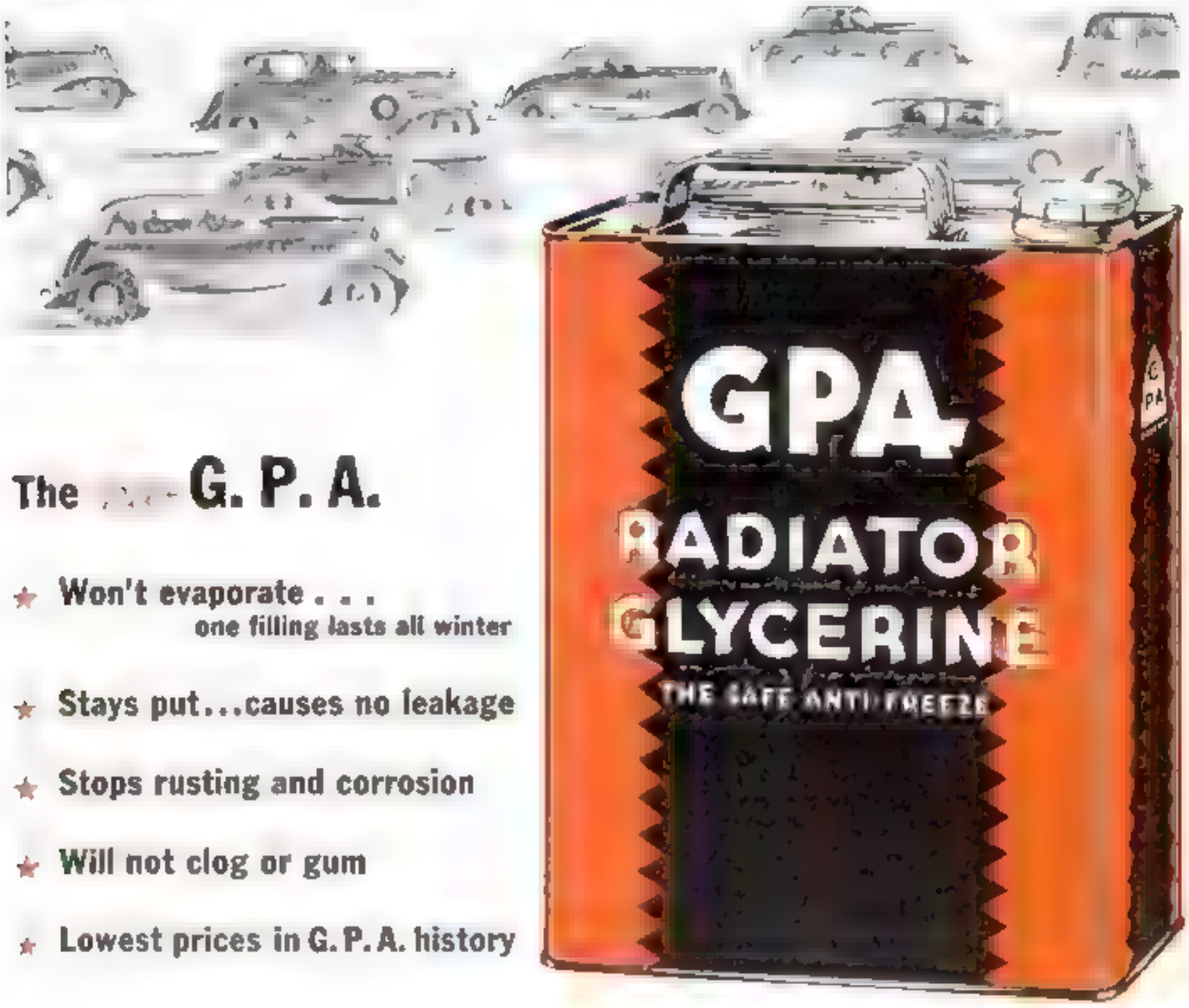
City . . . State . . .

(Please print name very clearly.)

Note: Prices of all kits except *F* and *H* are 10 per cent higher west of the Mississippi River because of heavy shipping charges. We overlay the postage on both cash orders and C. O. D. orders, but if you order C. O. D. you will have to pay on delivery the extra charges made by the Post Office which amount to 28 cents. Kits *F* and *H* cannot be sent C. O. D. This offer is made only to readers in the United States.

1933's

biggest anti-freeze bargain



The G. P. A.

- ★ Won't evaporate . . . one filling lasts all winter
- ★ Stays put...causes no leakage
- ★ Stops rusting and corrosion
- ★ Will not clog or gum
- ★ Lowest prices in G. P. A. history

● "It looks like G. P. A. has sure enough got the merchandise this year. She's a First Class, Grade A anti-freeze bargain, if I ever hope to see one!"

That's what garagemen and car-owners are saying about the new G. P. A. Radiator Glycerine this year. Here are some reasons why G. P. A. is such a bargain!

G. P. A. won't evaporate. One filling lasts all winter—no refillings required. With G. P. A. the first cost is the last cost. And this year the "first cost" is the lowest in history. Prices reduced last year, reduced *again* this year! Everybody can afford it now.

Price... permanence... those are two main reasons why G. P. A. is the anti-freeze bargain of 1933. There are twelve other good ones. For instance: G. P. A. stops radiator rusting; retards disintegration of rubber. Does not cause leakage. Will not clog or gum. Does not cause overheating. Has no unpleasant odor. Will not injure Duco.

G. P. A. is approved and endorsed by automobile and radiator manufacturers. They tested it in their own laboratories before giving it their stamp of approval.

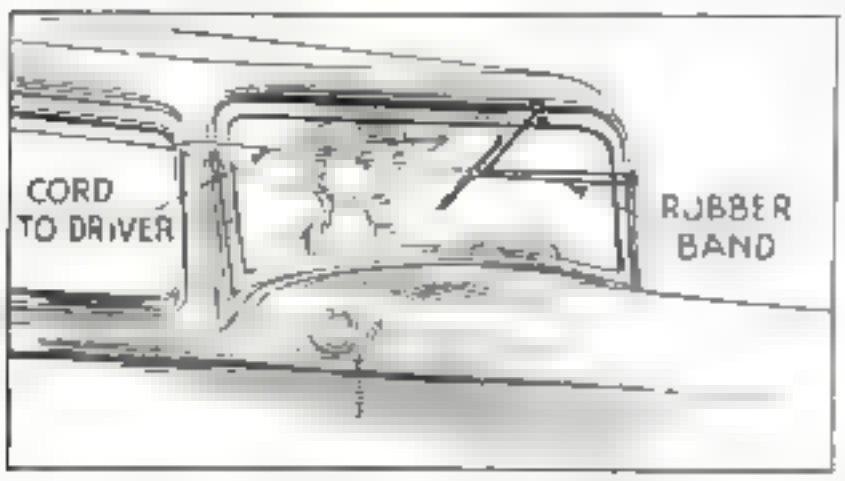
Fill up with G. P. A. *now*. It won't evaporate, so it's perfectly safe to put it in your car *early*. In that way you avoid all danger of a costly, early-season freeze-up.

Be sure you get genuine G. P. A.—look the red and black can square in the face. And get *enough* for adequate protection. Most important of all, DO IT NOW!

Glycerine Producers' Association, 386 Fourth Ave., New York.

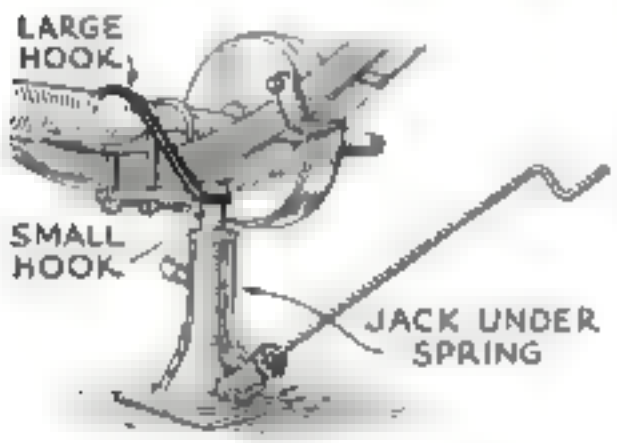
Useful Hints *for* Your Car

Our Readers Describe Simple Ways of Solving Many Common Motor Troubles



Handy Windshield Wiper

IF A storm comes up suddenly and your automatic windshield wiper fails to work, you can operate it temporarily with a piece of string and a rubber band. Simply fasten the elastic and the string to the wiper blade where it joins the moving arm. Then hook the rubber band over the top hinge of the front-left door and lead the string through the partially opened window of the opposite door. Pulling the string will move the wiper to the right while the elastic band will pull it to the left. It can be operated without interfering with driving.—F. J. S



Holder for the Jack

ALTHOUGH it is often necessary to place a jack under the springs instead of the axle especially on low-slung cars, they have been known to slip and cause serious injury. You can avoid this by using the simple safety stay rod shown in the illustration. The stay consists of a length of three-eighths-inch iron rod bent to form two hooks, a large one vertically and a smaller one horizontally. In use the large loop is hooked over the axle while the smaller one grips the neck of the jack. Being linked to the axle, the jack can not slip backwards and drop the car. This small device, insuring safety and protecting your car is decidedly worth while making.—E. T. C., Jr.

Homemade Trouble Light

BY SALVAGING an old flash light and several feet of lamp cord from my scrap heap. I added a trouble lamp to my car's repair kit. After removing the old batteries, I soldered the lamp cord ends to the two terminals inside the flash-light case and connected midget-battery clips to the two other ends. Then I bought a suction-cup coat hanger (any type of suction cup device will do), removed the rubber cup, and, by means of a rectangular slot cut in the flash-light case and a sixteen penny nail, fastened the cup to the side of the case. Now I can have my trouble light where I want it. All I have to do is snap one

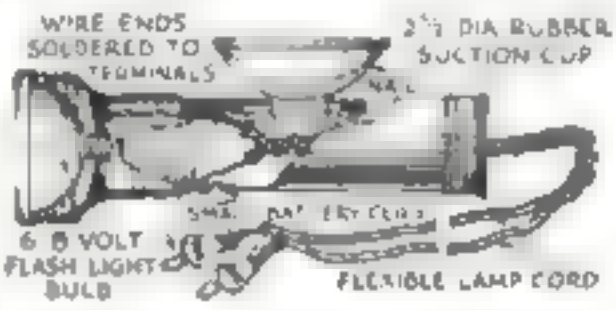
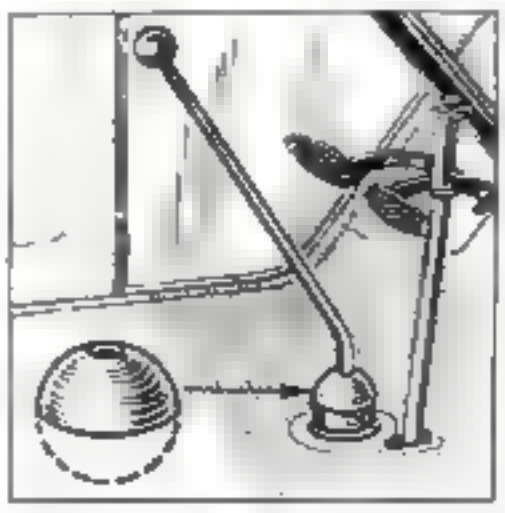


Diagram shows construction of trouble light

battery clip to the frame of my car and the other to any wire that has battery current in it. To place the light in use is simply a matter of a few seconds to push the suction cup against some smooth surface to make it stick and there I have my light convenient for use on a moment's notice and at a time when it is seriously needed.—W. B. M.

Protects You from Grease

AS A car gets older, the ball joint at the base of the gear shift lever often tends to ooze grease and grime. To protect your shoes and clothing, you can make a grease cover by placing half of a rubber ball over the lever joint. A hole cut in the top of the half ball will allow you to slip it over the shift rod and prevent the escape of grease.—F. M.



Half a rubber ball, with hole cut in it, is put over shift rod above lever joint

A stand to tighten chains

To Fasten Tire Chains

OF ALL cold weather jobs, that of fastening tight the tire chains is probably the most irksome. You can avoid the barked knuckles and number fingers usually associated with the task by making the chain fastener illustrated. The tool consists of a narrow strip of iron or steel notched at one end, and furnished with a movable hook-shaped steel link. The inside border of the chain is fastened first and then the tool, placed as shown is used to close the outer links. No matter how snug the chain, a slight downward pressure on the handle will draw the ends of the chain together.—K. S.

Handle for Battery

CARRYING automobile batteries is a back straining job unless a handle is used. The amateur mechanic can make a handle from two large washers and a fifteen-inch length of leather strap. Select two washers having one-half-inch diameter holes and, with a hack saw, cut a one-eighth-inch slot across the face of each. These slots will take the looped ends of the strap as shown in the drawing. To use the handle, simply drop a washer over each terminal of the battery and connect the strap. The weight of the battery will make the washers bind on the terminals and provide a vise-like grip.—D. D.

New Kind of Band Saw

New 14-in. "Delta" Band Saw Embodies Remarkable New Features Never Before Found in This Type of Machine

BASIC new changes that actually increase efficiency, accuracy and convenience of operation—are to be found in this astonishing 1934 "Delta" motor-driven tool. It is the first really improved band saw in years! Has new Independent Micrometer Adjustments for guides, Tilting Table on ingenious Double Trunnion Supports, Increasable Capacity Frame, New Safety Disc Type Wheels, New convenient arrangement for quick, accurate adjustment and many other features. Can use ¾" wide blade. Convertible into metal cutting saw, with proper slow speed. Priced surprisingly low, within the reach of all. Every woodworker, whether in home or factory workshop, should learn the full details about this revolutionary new "Delta" Band Saw.

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Every man who works with wood—in factory or home workshop—will want to get this FREE 1934 "Delta" Catalog of Quality Woodworking Tools. It shows the full line of latest "Delta" Tools. It is packed with interesting illustrations and descriptions. It describes the latest developments in motor-driven equipment at the astonishingly low "Delta" prices. Be sure you get YOUR copy. Mail the coupon TODAY!

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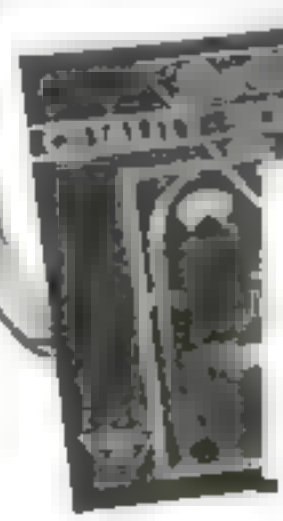

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Leonard F. Merrill, woodsman and guide, reveals the secret of

Mounting a Deer Head

SO THAT IT DOESN'T LOOK STUFFED

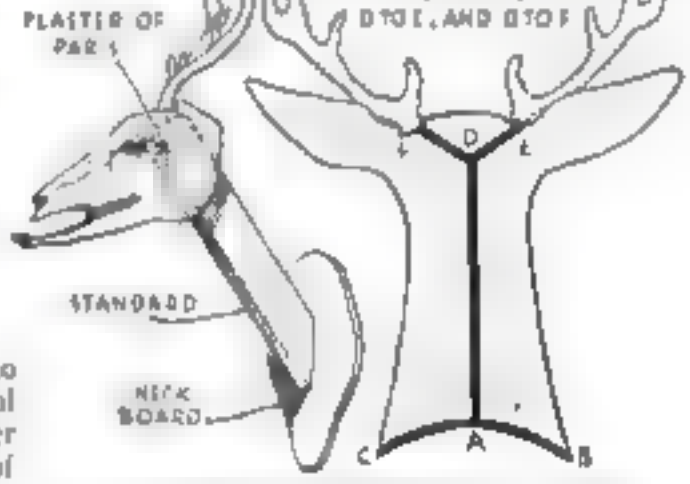
Expertly skinned and mounted the head of a deer can be made to appear amazingly true to life

A WELL-MOUNTED deer head is a source of continual satisfaction to the sportsman who bagged the animal, and if he mounts the head himself his pleasure is increased a hundredfold.

Even the professional taxidermist has no secret formula by which he can take a poorly prepared, burned, or rotted skin and make a perfect mounted specimen of it. At best it will have a stuffed and lifeless look. It is obvious therefore that some thought and care must be given to the preparation of the trophy when the animal is first killed and without delay.

Tools. Only two or three tools are necessary for skinning and preparing the head—a tape measure, skinning knife with a short curved blade, cartilage knife or scalpel, a pair of sharp-pointed scissors, and plenty of fine salt. To mount the head there must be added the usual assortment of woodworking tools necessary to make a panel or shield and

The first incision is made on the back of the neck at the point where shoulder and neck are joined. The direction of the cuts is shown by the heavy lines in the diagram at right. Later the cuts are sewn up as shown in the circle



How the skull is supported on a wooden standard, and diagram of the first incisions

The utmost care must be taken in setting the eyes, which give most of the expression to the head. The nostrils, too, should be deep or the deer will look as if it died of asthma

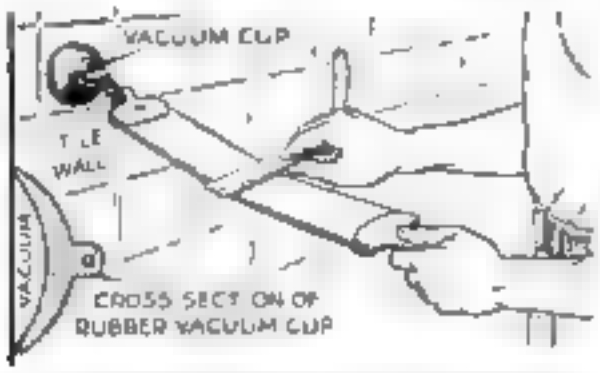
for fastening the head to the shield. The special tools necessary are: a good skin scraper for thinning the skin, three needles of different sizes for sewing up the cuts made in skinning, repairing possible fractures, and sewing through the manikin, a steel thimble, and a small wooden modeling tool to be used in fixing the eyes and shaping the nostrils.

Materials. Three pieces of wood are needed: one hardwood panel, one piece of pine about 9 in. square and ¾ in. thick for a neck piece, and one piece about 1½ in. thick, 3 in. wide and about 20 in. long for the standard. Some strong and well-waxed linen thread, plaster of Paris, long fibered manila tow, potter's clay, excelsior, a pair of glass eyes, tubes of Vandyke brown and black oil colors, a piece of sheet lead for the ear forms, and various nails, screws, and tacks should be on hand. The materials for poisoning and preserving the skin are listed at the end of this article.

Field Work. To skin the head, make an incision on the back of the neck at the point where the neck joins the shoulders. With the blade of the knife turned so that the cutting edge is up, run the point of the knife down one side of the neck to the underside. Keep well in toward the shoulders with the knife just under the skin and not pressed into the flesh. Do the same on the other side of the neck and join the two cuts. Now, starting at the first point, slit the skin straight up the back of the neck to a point halfway between the ears. From this point branch off right and left, and slit straight up to the base of each antler, forming a Y-shaped cut.

Start at the base of the neck and skin down, first one side and then the other, until the ears are reached. To do this skinning, hold the edge of the skin in one hand and (Continued on page 100)

RAZOR STROP FASTENED WITH VACUUM CUP

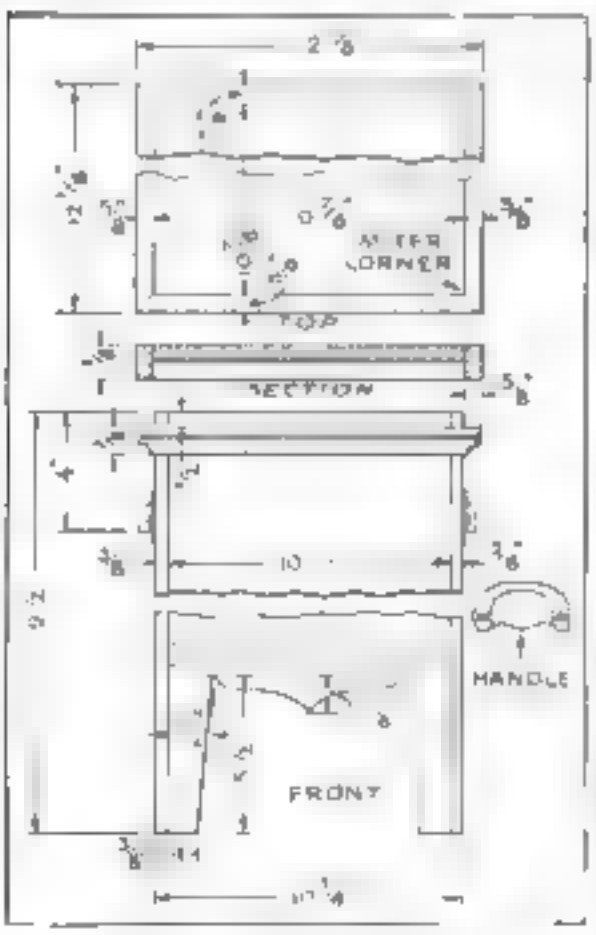


When fitted with a vacuum cup a razor strop can be firmly fastened to any smooth surface

WITH the aid of an ordinary vacuum cup, a razor strop can be fastened to a tile wall or any other smooth surface in the most convenient position for use. The easiest way to obtain a rubber cup is to buy a wall coat hook at a 5 and 10 cent store, break the metal part and tie the cup to the razor strop.—Martin G. Winterton.

WASTEPAPER BOX AND SEAT FOR KITCHEN

THIS combination wastepaper box and seat is a useful piece of furniture for the kitchen. The box is made from two pieces [illegible] by 14½ by 14½ in. and two pieces [illegible] by 10 by 14½ in. The lower edges of these pieces are beveled to form the legs. Cut a piece 10 by 10 in. for the bottom. Around the top edge place a molding about ½ by ¾ in. or a plain strip slightly rounded on the lower outside edge. The cover is ¾ by 10 ¾ by 10 ¾ in. Outside this fit by 1 ¼ in. strips are nailed with mitered corners to hold the cover in place on the box. Give the piece a white cream or light green enamel finish and trim in any way desired. Add two brass drawer pulls or make suitable wooden handles.—W. F. Rettig.



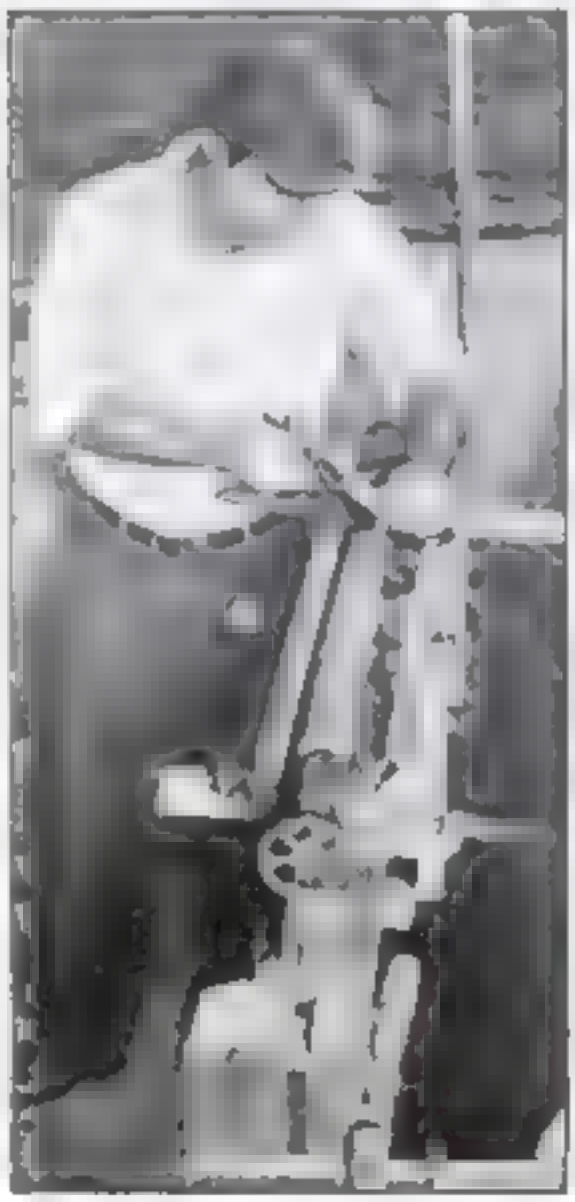
This easily made piece of kitchen furniture has its legs shaped out of the sidepieces

Using a PLANE to Aid in Turning Wood

By R. C. RANDLE

MANY amateur woodworkers who have tried to turn a true cylinder or a uniform taper have found it to be quite a job. With the use of the turning jig illustrated however, the beginner can do work equal to a professional wood turner

The jig requires four standard holders for tool rests, four pieces of iron rod or pipe about 1 ft long and of a diameter to fit the tool holders, four stove or machine bolts; and two straight pieces of wood (large enough so they will not be springy). The four iron rods or lengths of pipe must be heated and flattened for about 2 in. at one end, and a hole ¼ or 5/16 in. in diameter drilled in each at approximately the center of the flattened part. Most lathes are already equipped with two holders, and two more can be purchased from the manufacturer, or substitutes can be made of oak, maple or other hard wood. This was done in the installation shown, where the rear guide is supported by two wooden brackets.



Two strips of wood guide the plane and insure absolute accuracy and uniformity

Each piece is rough-turned to a size from ⅛ to ¼ in. larger than the finished diameter. When the last piece is in the lathe, its ends are turned to the exact dimensions with a slight allowance for sanding if necessary The jig is then set up The guides, which are straight pieces of wood, should be the full length of the work being turned. The pieces of rod or pipe are bolted to the guides and then placed in the holders exactly like an ordinary wide tool support except that there is one on each side of the work

The top edges of the guides are adjusted to the same height above the lathe bed as the top of the finished ends of the work that is, a straightedge resting on the guides should just clear the ends of the work where they have been turned to the correct size. Both guides should be the same height above the lathe bed

A carpenter's plane, turned at a slight angle to give a shearing cut is then used for finishing the work to the correct size. Rest the bottom of the plane on the guides, with the cutter over the center of the work, and slide the plane along both guides from end to end. All the pieces are finished without any further adjustment of the guides. The result will be that all are uniform and accurate

The same method may be used for more complicated turnings simply by replacing the straight guides with guides cut to the desired outline and using, instead of a common plane what is called a plow This should have a narrow skew cutter, ¼ or 3/16 in is the best size With a little practice and some assistance from the regular turning chisels and gouges, the amateur can quickly produce turnings which are uniform as to size and shape.

A word of caution. In setting any except the straight guides it is necessary to take special pains to get the guides parallel to the axis of the work and exactly opposite each other The easiest way to do this is first to set the guides at the correct height, then remove the work from the centers and measure equal distances from the centers to the inside of the guides. A carpenter's square is next placed against the inside of one guide even with the end and the end of the opposite guide is aligned with the edge of the square. No dimensions are given as these will vary with different types of lathes

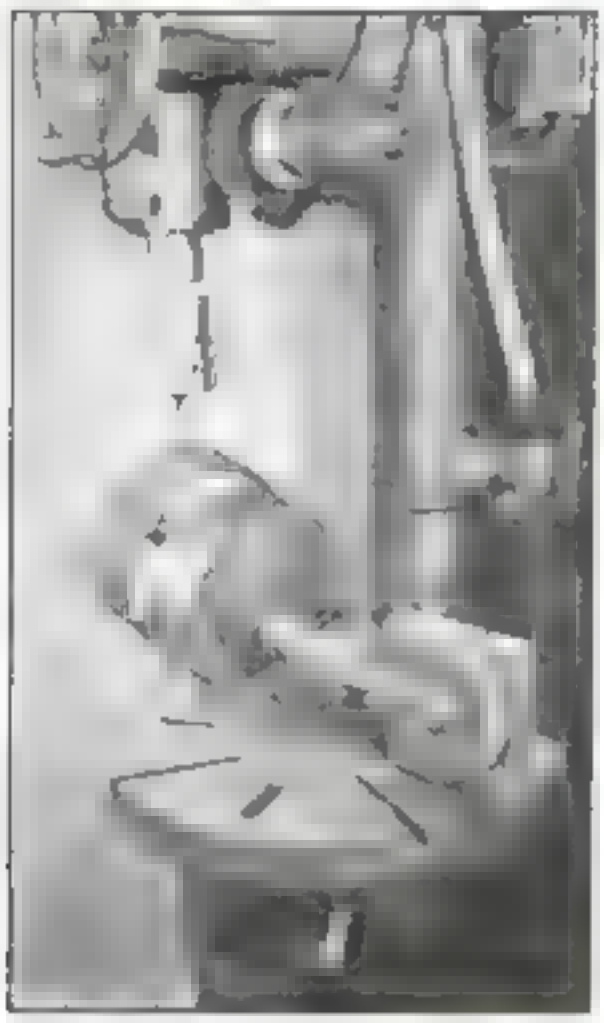
HINGES FOR MODELS

IN BUILDING a model of the stagecoach *Diamond Tally-Ho*, I obtained small hinges by taking them from tin cigarette boxes Such hinges may easily be removed, cut to shape, and screwed in place.—J A L

ENLARGING DRILL HOLES

IT IS often difficult to enlarge a hole already drilled because the second drill will not start without chattering This usually may be avoided by putting a ball of waste or a rag beneath the drill point and drilling through it.—W W Lyon

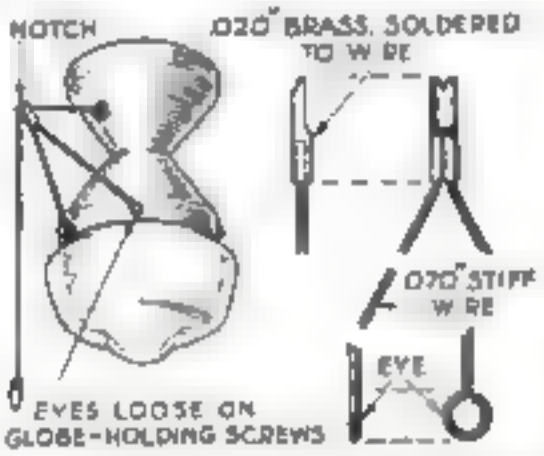
LATHE CHUCK SERVES AS UNIVERSAL DRILL VISE



The chuck is mounted on a special casting that is bolted to an ordinary angle plate

A LATHE chuck can be made to serve as a universal drilling vise for holding parts at an angle and for drilling odd shaped pieces. All that is required is a casting like that shown in the photograph below threaded to fit the lathe chuck. This casting is bolted to an angle plate which in turn is bolted to the drill press table. With this arrangement the part to be drilled can be held at any desired angle. A lathe faceplate can be used in place of the chuck, if necessary, for holding special work.—V. C. H

LIGHT-CHAIN BRACKET



IN MANY of the conventional kitchen ceiling lights, the pull cord rubs against the glass globe of the fixture. When the socket mechanism does not move freely considerable side pressure is exerted on the glass, and sometimes the holding screws become loose and the globe is in danger of falling.

A simple remedy is to use a V-shaped fulcrum as shown. Two legs of this attachment pivot on the screws holding the globe, while a narrow slot in the opposite end fits between adjacent balls on the pull chain.—ROLAND LJUNGQUIST

OPEN *or* SHUT, *this simple* Four-Leaf Table

always remains square

An occasional table of this type has innumerable uses in every home

THIS easily made but distinctive little table may be used for many purposes for example, to play a game of cards or chess, to serve coffee, tea, or other light refreshments, and to do typewriting, drawing or sewing. The fact that the table can be extended to twice its area by a simple system of folding leaves and supporting brackets adds to its convenience and usefulness.

Most extension tables are difficult to make but the construction of this one is within reach of almost every woodworker. The first step should be to get out the material for the legs and rails. When squaring the legs to dimensions, it is best to plane one side until it is straight and flat. Test it for flatness on a flat surface, and then plane an adjoining side square with the first one. Repeat on the other three legs. Now set a marking gage to the desired width and gage lines from the two squared sides on all four legs. Plane to these gage lines and saw to length. The taper is laid out by subtracting the least thickness, $\frac{7}{8}$ in., from the greatest thickness, 1½ in., and dividing the result by two (3/16 in.). Gage this on the ends of all the legs as shown in the detail drawing of the leg. Draw tapering lines to a point ½ in. below the rails, and plane to these lines.

The rails are made 2¾ in. wide. A strip ¾ by ½ by 10 in. is then cut into two pieces (7 and 3 in.) at an angle of 45 deg. and glued to the upper edge of each rail as shown.

The mortise and tenon joints are now laid out according to the drawing. Place the four rails edge to edge on the bench and lay out the shoulder cuts.

Then gage the thickness of the tenons in the center of the end wood. Gage from the outside surface of each rail. Place the four legs together with the squared sides in. Mark all the other sides "out." Gage the mortises in the center of the legs from the faces marked "out."

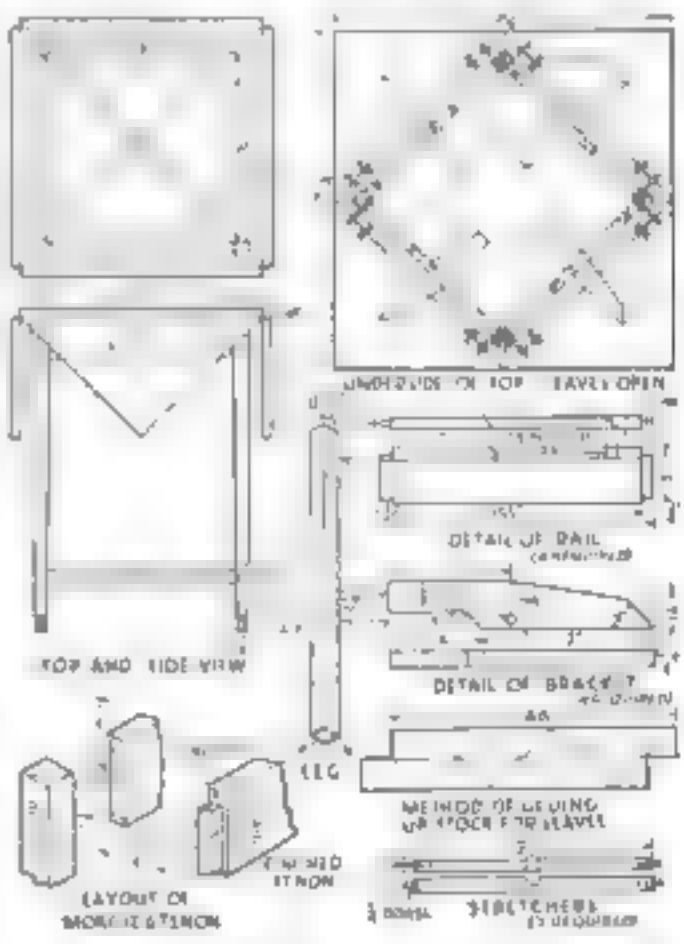
Saw the tenons on the outside of the rails. Bore a series of holes as close together as possible for the mortises inside the gage lines. Bore a series of holes as close together as possible for the mortises inside the gage lines, and finish the edges and ends with a chisel. Bevel the inside end of each tenon as shown and fit the joints together, one at a time. Number each completed joint so that it can be put together quickly when gluing.

Clamp the legs and rails together without glue and measure the length of the stretchers. Cut them a little longer than needed and make a cross-lap joint in the center. Lay out the exact length and make the 45-deg. V-cuts on the ends. The stretchers are joined to the legs with ⅜-in. dowels.

The table is now ready for gluing. It is advisable to glue two opposite sides first, and when these are dry, to glue the remaining two rails and stretchers. The brackets are then made and fastened to the rails with the ¾-in. dowels upon which they turn. These dowels need not be glued.

The top should be made of three or four boards glued together because it is less likely to warp than if it were made from wide boards. The leaves can be made most economically if the stock is glued up as shown in one of the detail drawings. When jointing (planing) the edges for gluing, plane both edges at the same time. Test the joint by placing the two edges together and look at toward the light. Be sure that the joints are tight at the ends, but a little light may show through in the middle.

The top and leaves are then planed and squared to dimensions. The leaves are fas-



Assembly views, a drawing of the underside showing the leaves open, and details of all the parts

tened to the top with eight hinges as shown. Smooth off any unevenness with a cabinet scraper and sandpaper on the upper sides of top and leaves. The legs and rails are screwed to the top with 3-in. No. 12 screws. A hole ½ in. in diameter and 1 in. deep is bored for each screw. This is then continued through the rail with a 7/32-in. bit.

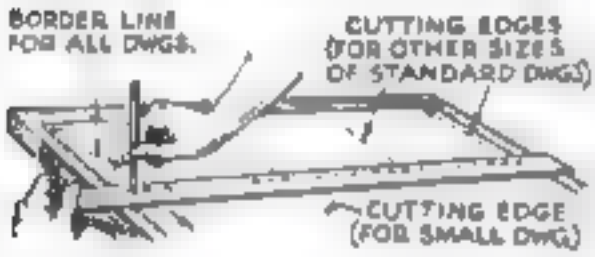
Inspect every surface for any defects and give the table a thorough sanding with No. 2/0 sandpaper. If a light colored stain is used, it looks well to stain the ends of the legs black for contrast. Cut a fine knife line around each end to prevent the black stain from running over on the light surfaces. If made of a close-grained hardwood such as birch, the table need not be fixed, but may be given four coats of very thin shellac. Each coat should be rubbed down with No. 2/0 or 3/0 steel wool. The last coat should then be rubbed down to a smooth, satiny finish with No. 5/0 waterproof sandpaper. If a high luster is desired, the table should be given two coats of clear lacquer after the second coat of shellac.

List of Materials

No. Pieces	Description	T	W	L
4	Legs	1		
4	Rails			17
4	Strips for rails			10
	Stretchers			
1	Top		20	20
	Four leaves		5	48
4	Brackets			
8	Flat joint butt hinges			
4	Dowels			
4	Dowels			
1	Screws		No. 1	

Note: All dimensions are given in inches.

HOLES IN T-SQUARE AID IN DRAWING BORDERS



Vertical cutting lines and borders can be drawn without measuring or using a triangle

A draftsman can avoid a lot of unnecessary remeasuring of standard size drawings and save squaring up vertical lines with triangles by making holes in his T-square as shown in the accompanying drawing. His pencil point will fit in the holes so made, and the T-square is simply run up and down to mark the desired border lines and cutting edges. More varied work can be done in the same way by drilling holes accurately along the T-square 1 in. apart or spaced at whatever intervals are found most useful. This arrangement promises to be of such utility that a patent has been applied for.—William A. Rosba.

WATERPROOFING MOCCASINS

For use in cold weather, moccasins can be waterproofed by rubbing on the following mixture. Equal parts of beeswax, tallow (either deer or mutton), and neatsfoot oil well melted together. Another method, which is used by the Norwegians, is better if the materials are available. Two parts of pine tar and three parts of cod liver oil are boiled together and the moccasins are soaked in the mixture, which is cooled to while still hot.

For summer or warm weather wear moccasins should not be waterproofed, as this would make the feet perspire too much and cause scalding.—L. F. M.

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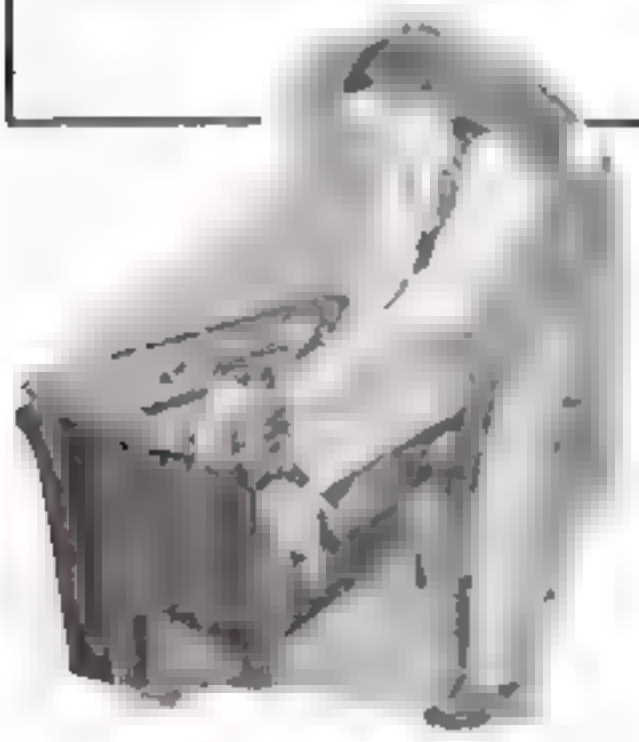

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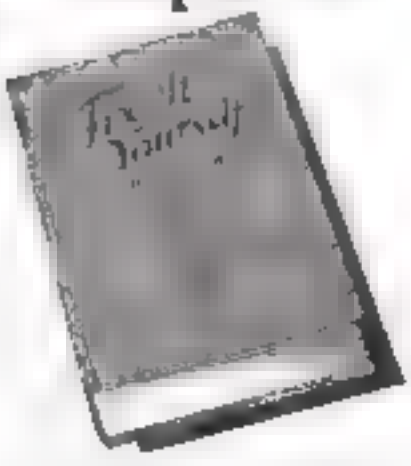

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MAKING SHIP MODEL FITTINGS

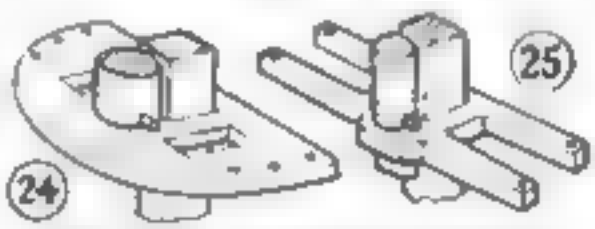
Continued from page 67

chains, but as they are unshipped when not in use, should not be put on. The rims were frequently painted red, with the rest green or black.

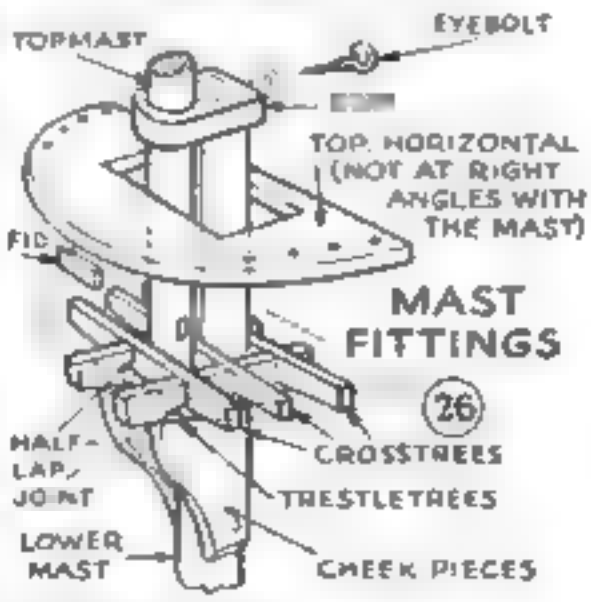
Ladders. There are all sorts of ways of making wooden ladders. The following is the method I have found most satisfactory. Cut strips for the sides and steps, noting that the latter should be thinner and wider. Try out for the angle of the tops, bottoms and steps so that all will be horizontal when the ladder is in position. Mark inside the sides to this angle (with a bevel or on a drawing board) at the position where the steps are to go, and there file V-notches. Cut all the steps exactly to the one length. The easiest way to do this is to make them a shade long, clamp them together, and file the ends square. Then cut the ends to fit the V's.

Place a piece of paper on a board and firmly press in two steel pins or nails (Fig. 18). Glue one set of notches and place the side on edge against the pins, glue the ends of the steps and place in the notches, glue the other sidepiece; press all together and fasten with two more pins. Remove the ladder when the glue is dry and lightly rub face and back on sandpaper. If at all possible, nail as well as glue ladders in position.

I am indebted to W. F. Barnaby for the following idea for making iron ladders. Take a block of pine larger than the ladder to be made. Rule lines across at the spacing required between rungs. Along the two top edges (Fig. 19) make thin knife cuts where the cross lines meet the edges. The long way of the block, rule parallel lines spaced the width of the ladder. About ½ in. from each end drive brads on each parallel line. Stretch taut wires from the long way about ⅛ in. above the block surface. Put soldering paste along these wires. Tie a knot in one end of the wire to be used for the rungs. Catch it in a knife cut and proceed to wind the wire around and around the block, catching each turn in its knife cut. Align the rungs by the ruled cross lines (omitted from the sketch for clarity), and solder. Use very little solder and just touch each joint. Snap off the rung wires near the edge cuts, remove the ladder from the brads, and trim it with scissors.



SIMPLIFIED TOPS AND CROSSTREES FOR SMALL MODELS OF THIN WOOD, CELLULOID, OR FIBER



Simplified mast tops and crosstrees, and a more complete arrangement for a larger model.

The block may be utilized over and over.

Spars. Masts, yards, and booms can be made from any wood, but as they must undergo considerable strain and carry many fittings, a nonsplitting wood with much longitudinal strength is essential. Some model makers like to use degame (lemonwood). This has longitudinal strength, works to a fine finish, and is good looking, but it is inclined to split. My own preference is birch which has the advantage of being easily obtained nearly to size in the form of dowel sticks. Only the best, whitest, straight-grained sticks should be used. The plane should run equally smoothly on all sides.

Figureheads may be carved or modeled.

Spars can be turned if you have the right kind of lathe, but I find it quicker and easier to plane and sandpaper them to shape. Use a fine set plane and a true surface to lay them on (Fig. 1). Plane an entire mast or one end of a yard before cutting it from the long stick, so that you have something to hold.

I find it easier to plane very small spars by holding the plane face up between my knees and drawing the spar with a diagonal cut over its face (Fig. 17).

The correct proportions of yards is given in Fig. 20. It is not necessary to gage each section, but it is wise to have them in mind. The details of spar making, of course, vary with the period, but the general proportions and main features are constant.

Yard Fittings. Before the spars are put in position, they require a number of fittings. Quite important on a model of ¾ in. or even less scale are the jackstays and footropes of the yards. On the ¼-in. scale I use No. 24 brass wire for the jackstays, threading it through eyebolts on the yard just aboft the middle line. These eyebolts can be made from ⅜-in. pins bent to shape, but a neater bolt is made by flattening the pin head and drilling a hole through.

I find small snatch blocks difficult to keep in place, so substitute No. 32 or smaller silk-covered magnet wire, dyed black. Just bend the ends over for the splices, with a small silk seizing to hold them.

The yards need spider (eyebolt) bands at the ends for the braces and lifts. These are most easily made by twisting No. 24 wire to shape and twisting the ends tightly under the yards, then pressing them into the wood. A neater band can be made from a section of thin brass tube, bored for little eyes, which are soldered in position. Both types are shown in Fig. 20.

The lower yards and lower topmast yards require trusses on which they can swing horizontally and vertically. There are several shapes on real ships and various ways of making them. I have found the following comparatively easy and sufficiently correct. The arm (Fig. 21) is No. 16 soft wire, hammered flat at the ends and slightly flattened in the middle, where it is bored for a No. 20 escutcheon pin. This is put through flattened close up, and bored vertically for another pin. Two bands with projecting ends are made to fit around the yard. The ends of the arm are soldered between these lugs. Make a dummy yard of the same size as the real one on which to do this. A band to go around the *(Continued on page 85)*

SHIP MODEL FITTINGS

(Continued from page 84)

mast, is made; to this is soldered a U-shaped piece. A pin goes through these lugs vertically, as shown. A touch of solder on the end will hold the pin.

A lower topsail yard truss is similar, but with the smallest possible distance between the mast and yard.

Mast Fittings. The most important fittings for the masts are the caps, tops, and crosstrees. The caps (Fig. 26) can be cut from hardwood, but fiber board or celluloid is more satisfactory, especially the former. If the cap is inclined to split, file a groove and wind two turns of thin wire tightly around it. Caps usually have various eyebolts in them. Drill through into the masts for these, if necessary, to gain a more secure hold.

A top in a small, simplified model can be cut from one piece of fiber or celluloid (Fig. 24), but is, of course, better built up with regular trestletrees and crosstrees (Fig. 26). The former lie fore and aft and are bolted to the mast, and the latter lie across the former and are half-flapped into them. A rim is built touching the ends of these, and the middle is partly planked in. Note that tops lie horizontal, not at a right angle to the mast.

Crosstrees (Fig. 25) are like the tops, but without the rim or flooring. Holly or gum is good for making such parts.

Figureheads. Ships have different figureheads, all of which have the feature of blending the line of the stem into the line of the bowsprit. Small figures can be made directly on the model by sticking one or more pins in the stem and on them modeling the figure with gesso applied on the point of a stick. Some final trimming can be done with a file. Some modelers prefer to use a plastic wood composition.

For a larger figurehead (Fig. 27) it is better to erect a dummy stem and mold or carve the ornament from boxwood or that. Glue and nail it in place when finished.

This is the third of a series of ship-model articles on tools, materials, and methods. In a following article Captain McCann will give suggestions for making dradeyes, blocks, and soft metal castings.

PROTECTING AN OUTSIDE FAUCET FROM FREEZING

THE end of warm weather need not mean the end of the usefulness of the outdoor faucet. To insure against its freezing and still keep it available for use without a trip to the basement to turn on the inside valve, I ran an extension from this cut-off valve to the outside of the house. With this extension the water may be turned on and off from the outside, yet the portion of the pipe exposed to the cold is well drained at all times when not in use and there is no danger of freezing.—RALPH W. MCPHERSON.

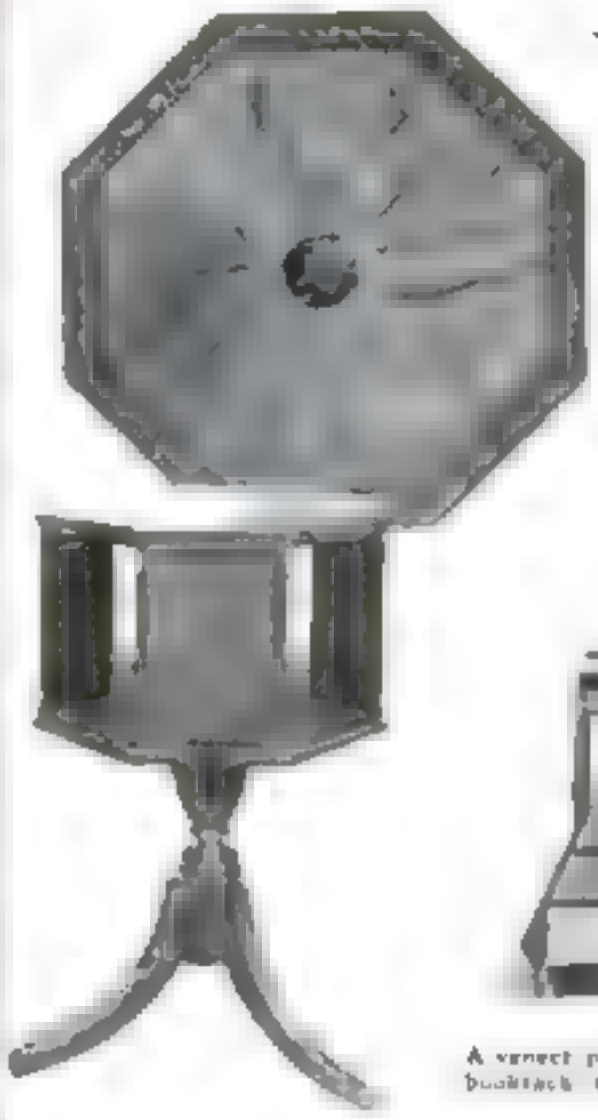
GLUE PREVENTS KNOTS FROM SLIPPING

HAVE you ever tried to tie a knot in the end of a new or slippery rope or cord to prevent unraveling, only to find that the knot would not hold? Sometimes such a knot is depended upon to keep the load knot from slipping, and an accident may result if it does not hold. To prevent slipping, simply dip the knot in glue and allow the glue to dry. This kink is equally useful in securing knots tied in thread and other thin lines used for rigging ship models. In this case the glue can be applied with a small brush.—W. F. SCHAFHORST.

NOW EVERY WOODWORKER CAN DO

Beautiful Veneering

By Herman Hjorth



A veneer piece of the type used by amateurs. The revolving bookrack is of figured maple with borders of rosewood

VENEERING should no longer be neglected by the home craftsman. The new white and practically stainless glues of casein type now available and the ease with which high grade veneers of all kinds may be obtained in small quantities have solved two of the difficulties that have before discouraged amateur woodworkers.

Many still think that the purpose of veneering is to cover a cheaper kind of wood with thin layers of more expensive wood in order to create a false impression and that solid wood is much better, stronger, and more beautiful. As a matter of fact the opposite is the case. And the woodworker who has never done veneering before has a great thrill in store when he first engages in the fascinating craft.

From a structural point of view veneered work is stronger and more durable than solid wood because it will not crack and is not prone to warp and to warp. It is true that veneer presents the edge grain of wood, which is weaker than the side grain, but this edge is protected by the veneer and is not exposed to steam heat or to dampness. In that respect veneered construction may be considered as one that is weather heat resistant and waterproof. In order to understand the basic reasons for the superiority of veneered furniture we must have a knowledge of the characteristics of wood, the science of seasoning, and the chemistry of glue. Science has advanced greatly. It may therefore be stated that veneered furniture made at the present time is better and more scientifically constructed than that made a century ago, that it is stronger, more durable and more beautiful than that made of solid wood, and that it is, in short, the proper furniture for the modern home.

The truth of the statement can easily be verified by visiting a furniture store where [illegible] antique furniture is sold. Notice how the [illegible] table tops are warped or even

To glue the sawed edges of the veneer, the matching pieces are clamped between two boards. The joint is then held with brads while gummed paper tape is applied

cracked. Then examine the flat, flawless veneered surfaces of the modern furniture. No solid wood could be glued together in such beautiful patterns as many modern pieces display. Even if one could obtain and afford to buy solid rare woods of similar quality, they would warp and crack excessively because fancy woods of this kind are not structurally strong. They are therefore cut into thin sheets (veneer) and glued to plain, straight-grained woods. From the esthetic point of view nothing can add so much to the beauty of a wooden surface as figured veneers artistically combined. The purpose of veneering is therefore twofold, to improve the work structurally and to make it more beautiful.

While it is not the purpose of this article to deal with the mechanical processes of veneering, it should be pointed out that these are quite simple. No craftsman of average ability and intelligence need have any misgivings on that account. Furthermore very little equipment is needed. For cutting the veneer a small veneer saw, a strong knife, a chisel, or a

A veneered and inlaid jewel box. This is an especially suitable project for any beginner

thick plane iron may be used. If sawed, the veneers are clamped between two pieces of hardwood that are bolted together while their edges are planed straight and smooth. Ordinary thin brads about ¾ in. long may be used to hold the veneer in place while its edges are being taped together. A gummed paper tape of the kind used for sealing packages is suitable for this purpose.

The gluing used to be the most difficult part of the work, necessitating an oven, heating plates, and a press, but with modern cold-water or casein glue all this has been changed. It is still necessary to have a press for large work, but small pieces, not more than 12 in. square, may very well be clamped between a pair of straight, planed boards from 1½ to 2 in. thick. Hand screws or C-clamps may be used. Having made one or two small projects in this way, the ingenious craftsman may want to build a small press himself. A good part of the material for this may perhaps be obtained from the junkman. A small iron veneer press, however, with a platen 24 in. square can be bought for about $30. The pieces illustrated were all veneered on such a press. Among the woodworking projects that can be veneered to great advantage are all sorts of small table tops for coffee, sewing, smoking, serving, and end tables, book ends, revolving bookracks, jewel boxes, humidors, serving trays, tray tables, picture frames, mirror frames, drawer fronts, cabinet doors, clock cases, and checkerboards.

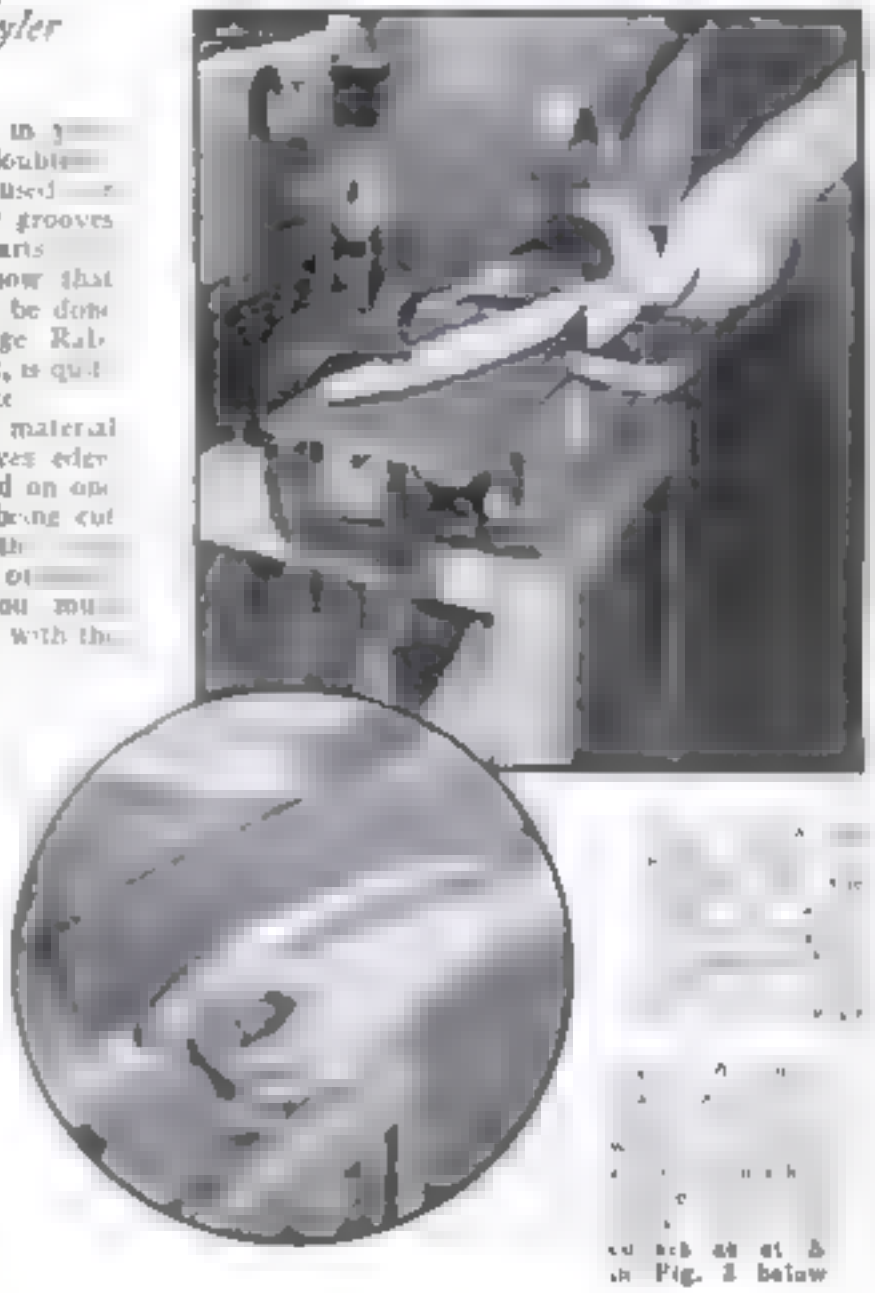
Veneers in small quantities may be obtained from almost any veneer dealer at a price of from 2 to 35c a square foot according to the material and quality of the wood. The average price of fine face veneers runs from 5 to 10c a square foot.

Mr. Hjorth is the author of the latest and most complete manual on veneering that has been written for amateurs, How to Make Veneered Panels. *Among his other books are* Principles of Woodworking *and* Basic Woodworking Processes.

Cutting Curved Rabbets

ON A SMALL JOINTER

By John E. Hyler



IF YOU have a jointer in your shop you have undoubtedly found that it can be used for cutting straight rabbets or grooves in the edges of wooden parts it may surprise you to know that curved rabbeting may also be done on the machine to advantage Rabbeting a convex edge, in fact, is quite simple after a little practice

Figure 2 shows a piece of material being rabbeted on the convex edge It has already been rabbeted on one side, and a rabbet is now being cut on the other side. To do this set the machine as for ordinary straight rabbeting, but you must keep the material in contact with the jointer gage or fence at a point directly over the center of the cutter head. After practice, you can do this sufficiently well with the unaided eye. At first, however, it will be well to put a mark on the jointer fence as shown in Fig. 3. *A* is the front bed, *B* the back bed, *C* the fence, *D* the cutter head, and *E* the mark mentioned

To make a good rabbet on the concave edge of a piece of material the fence is removed from the jointer The piece of waste material which has been hand sawed out of the material to be rabbeted, or another of the same radius, is used for a guide. It is necessary for the entire piece to ride around over the back jointer bed, however, and in order to make this possible, surface *F* in Fig. 4 is discarded, and the entire rear table is dropped down to bring surface *G* even with the surface of the front jointer bed *A*

To do this safely, first clamp the piece of hand-sawed waste, marked *J* in Fig. 3, down on the back bed as indicated in Fig. 1 *before* the back bed has been lowered, and after the front one has been set to the proper depth. This is done with the machine stopped

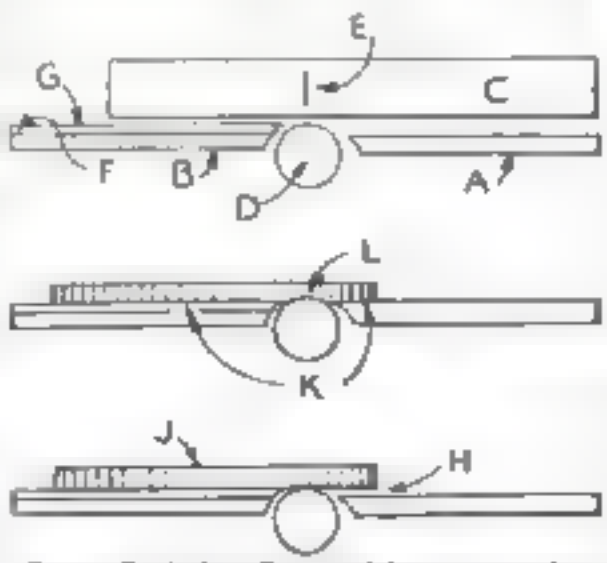


Fig. 3. Guide line *E* is used for convex rabbeting and form *J* for concave rabbeting

With the piece *J* firmly clamped start the machine and gradually lower the back table until the gap at *H* in Fig. 3 closes, and the entire piece is lying flat on both tables as shown at *K* The knives will cut out the portion marked *L* as the bed is lowered. In placing the piece *J* on the table for clamping arrange it so that a line radial to the circle of which its convex edge is part will be in line with the center of the cutter head or approximately so. For a ½-in rabbet, leave that much knife length exposed

You are now ready to make the cut Start it as shown in Fig. 1 and move the piece carefully forward, following on around until the entire cut has been made

TACKS SHOW LENGTH OF FISH

FISHERMEN can measure their big catches without delay if a scale is made by driving two dozen upholstery tacks 1 in. apart in the gunwale at one side of the boat.—K. M.

FASTENING PORCELAIN HANDLES

IF THE stopcock handles on a gas range become so loose that they wabble, clean the fitting with gasoline or denatured alcohol (being sure first that the fires and pilot light are out), then place a drop of shellac on the end of the thread and another in the collar into which the porcelain fits. Screw the handle tight, and it will give no further trouble.—ELTON STERRETT

THE TRICKS OF TAKING SALEABLE PHOTOS

(Continued from page 7)

each side. The lower of the two views was taken with exactly the same set-up except that the lights were moved around close to the camera.

Every home workshop picture and, in fact, every record picture of a still subject, should be taken with the lens diaphragm stopped down to the smallest opening and the exposure should be proportionately long. This is especially important on close-ups.

EVEN a relatively low-grade lens will give clean-cut, sharp pictures when used with the smallest stop, and the finest lens made will not show the nearest and farthest points of the object in sharp focus if a large stop is used. The lower of the two plane pictures on page 70, for example, was taken with the lens wide open. It was focused on the front edge of the plane. The upper picture is precisely the same except that the lens diaphragm was closed to the smallest stop and a longer exposure was given. Of course, it would have been much better to have focused on the mid point of the plane. Then both the front and the back of the plane would have been out of focus but the sharpness would not have been quite so apparent. Bear this point in mind and always focus so that the sharpness with the lens wide open, is evenly distributed between the nearest and farthest points of the subject. Use the smallest stop when you take the picture, but don't expect it to cover up too much in the way of careless focusing.

Injecting the human-interest element into your pictures in a natural way is not at all difficult. The first and most important rule is, never, under any circumstances, have the person in the picture looking at the camera. He should always be looking at what he is doing. The effect you want is the kind of picture you would get if you could steal up on the man while he is working with or inspecting the subject of the article and take the picture without his knowledge.

For any average home workshop subject, there should be at least one picture showing the completed object apparently being tested, inspected, or used by the maker. Include head, body, and hands in this view. A full-length shot is needed only if the object is quite large.

Then there should be one or more close-ups showing hands performing work on the object at interesting stages in its manufacture, and as many stills as may be necessary to illustrate all important details.

YOU cannot, of course, use a very small stop and give a long exposure with a human being in the picture unless the position is naturally a very steady one. Ordinarily a hand view, that is something shown held in the hands, or a view of a man holding some object such as a tool in working position calls for an exposure not much longer than one second. If the pose you want is one that is just naturally wabbly, you can use a photoflash bulb for this shot.

Until you have found by experience just what exposure seems best under your conditions, remember that the cost of the film is of trifling importance compared with the time and trouble you put into taking the picture. Take at least three shots of each view, tripling the exposure for one of the extra shots and cutting it to one third for the other. It is much better to waste the extra film this way than to have to take the picture over again, or what is still worse, send in unsatisfactory photographs to illustrate your article.

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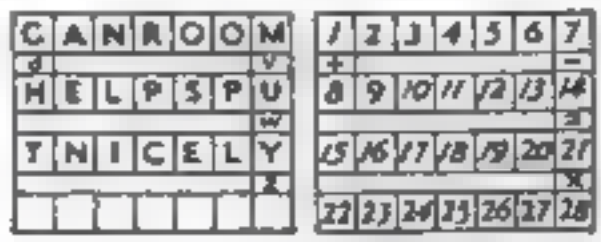
SOLVING THE POPULAR SCIENCE MONTHLY BLOCK PUZZLE

HOW many moves did you take to solve the POPULAR SCIENCE MONTHLY block puzzle that appeared last month (P. S. M., Oct., '33, p. 76)? The solution for the wording "CAN ROOM HELPS PUT NICELY" as worked out by Arthur L. Smith, who prepared the puzzle, is given below. It requires 107 moves. The displacement of each



At left—Starting positions of the blocks
At right—The spaces marked for reference

block is counted as a move except where two narrow blocks occupy the same square and can be moved together into another square. Each identical blank block is brought back to the space it originally occupied, since some puzzle solvers are likely to insist upon this formality.

For the purpose of recording the solution the blank squares are numbered from 1 to 28 in the accompanying diagram. The narrow spaces are given the symbols +, −, =, and ×. Let the narrow blocks over these symbols be d, v, w, and x respectively.

	From 28	Move 20	At 21X	To
1	M	21X	21X	C
2	14	1	7	1
3	x	1	21	7
4	14	1	21	8
5	x	1	21	R
6	M	15	1	4
7	15	1	4	8
8	2	16	1	5
9	16	1	5	4
10	x	17	1	1
11	17	1	1	P
12	1	8	8	1
13	8	8	8	11
14	2	9	9	1
15	9	1	10	10
16	1	10	10	1
17	10	1	1	11
18	1	11	11	1
19	11	1	1	12
20	1	12	12	1
21	12	1	1	13
22	1	13	13	1
23	13	1	1	14
24	1	14	14	1
25	14	1	1	15
26	1	15	15	1
27	15	1	1	16
28	1	16	16	1
29	16	1	1	17
30	1	17	17	1
31	17	1	1	18
32	1	18	18	1
33	18	1	1	19
34	1	19	19	1
35	19	1	1	20
36	1	20	20	1
37	20	1	1	21
38	1	21	21	1
39	21	1	1	22
40	1	22	22	1
41	22	1	1	23
42	1	23	23	1
43	23	1	1	24
44	1	24	24	1
45	24	1	1	25
46	1	25	25	1
47	25	1	1	26
48	1	26	26	1
49	26	1	1	27
50	1	27	27	1
51	27	1	1	28
52	1	28	28	1
53	28	1	1	27
54	1	27	27	1
55	27	1	1	26
56	1	26	26	1
57	26	1	1	25
58	1	25	25	1
59	25	1	1	24
60	1	24	24	1
61	24	1	1	23
62	1	23	23	1
63	23	1	1	22
64	1	22	22	1
65	22	1	1	21
66	1	21	21	1
67	21	1	1	20
68	1	20	20	1
69	20	1	1	19
70	1	19	19	1
71	19	1	1	18
72	1	18	18	1
73	18	1	1	17
74	1	17	17	1
75	17	1	1	16
76	1	16	16	1
77	16	1	1	15
78	1	15	15	1
79	15	1	1	14
80	1	14	14	1
81	14	1	1	13
82	1	13	13	1
83	13	1	1	12
84	1	12	12	1
85	12	1	1	11
86	1	11	11	1
87	11	1	1	10
88	1	10	10	1
89	10	1	1	9
90	1	9	9	1
91	9	1	1	8
92	1	8	8	1
93	8	1	1	7
94	1	7	7	1
95	7	1	1	6
96	1	6	6	1
97	6	1	1	5
98	1	5	5	1
99	5	1	1	4
100	1	4	4	1
101	4	1	1	3
102	1	3	3	1
103	3	1	1	2
104	1	2	2	1
105	2	1	1	1
106	1	1	1	1
107	1	1	1	1

Solvers may find it interesting to see if the solution can be accomplished in a less number of moves. Other combinations of letters will give a different series and may require a greater or less number.

REALISTIC PORTHOLES FOR SMALL MODELS

In making a 1-in. model of the U.S.S. *Indianapolis* I used ordinary pinheads to represent the portholes. After drilling a hole at each place with a pin and then countersinking them with a drill of a size to make a snug fit for the head, it is best to use a small block of wood on the drill as a gage to get the holes even in depth. They should be deep enough so that the pinheads will be set back a little to give a realistic porthole effect. The pins may be painted black or left shiny. I prefer the latter because they look more like glass. The pins are cut off about ⅛ in. long and set in with a small nail set. This scheme could be used on other miniature models if the proportions are correct.—C. S. Gilmore, Jr.

When ordering back issues of POPULAR SCIENCE MONTHLY, *please send 25 cents for each issue except the current one and the three issues immediately preceding. These four issues are only 15 cents each.*

SPEEDOMETERS WILL SOMETIMES TELL LIES

(Continued from page 60)

"Now, let's suppose the tires are worn down a half inch or undersized the same amount. That'll bring the diameter down to twenty-nine inches and the tire will space off three inches less every revolution. In a mile the error is three times six hundred and seventy-five or approximately two thousand inches.

"Changing that into miles," Gus continued to calculate, "will mean that every time the speedometer clocks a mile the car will have travelled one hundred and seventy feet less than a mile. In a trip of one thousand miles, that amounts to about thirty-five miles error.

"And the same thing happens if the tires are larger than they should be," Gus added. "Only the error will be in the other direction. The speedometer will read low."

As Gus talked, Al Taylor drew a small notebook from his coat pocket, ripped out several pages, and began tearing them into small bits.

"What's the matter now," Gus asked.

"A lot of good those gas and mileage figures will do me if my speedometer's wrong," the man groaned. "Here I've been keeping accurate account of the speedometer readings and the gas I bought in the hopes I could make an accurate test on my gas mileage."

Gus grinned. "Maybe your readings aren't as bad as I've painted them," he consoled. "True, you two fellows differed forty miles on a thousand-mile run but then those oversize shoes Otis is using will make his speedometer read low."

"How can we check them?" asked Otis.

"Simple enough," explained Gus. "Make sure your tires have the right amount of air in them and then go out on the Mount Rose highway where the automobile club has that measured mile. Just run the length of it several times and see what your speedometer reads.

"Of course, if you want to make a longer test take a trip some place where you're sure of the mileage. Then, when you've found out the error, if there is any, you can figure it in percentage."

"By the way, Gus, how about the miles-per-hour reading of a speedometer?" asked Otis. "Won't the size of the wheels affect that also?"

"Sure," said Gus. "The speed reading depends on the revolutions of the wheels just like the mileage. Naturally, if the wheels are smaller than they should be the speedometer will show a higher speed than it should. On the other hand, if the wheels are larger, it will read lower."

"Oh, so that's it, Al," Otis grinned with satisfaction. "No wonder you got that hunk of junk you call a car up to seventy when the best I've been able to do is sixty-seven. Your tires are worn and mine are oversize."

"Aw, go on," Taylor snapped back, "you couldn't get that crate of yours up to seventy if you used spools for wheels."

Gus shoved his pencil stub back in his pocket and walked out of the office.

Soon the door opened with a bang and the two men, still arguing loudly, appeared.

"What's up now?" Gus asked as they rushed toward their cars.

"We're going out to that measured mile," said Frank. "Maybe we can settle two arguments at once."

"You didn't do so well with them," Joe grinned as the two cars disappeared up the street. "They came here with one argument and left with two."

"Oh, well," drawled Gus, "I started them thinking anyway. And, if you don't think that's something, you don't know those two birds as well as I do."

COLORED LIGHTS AID YOUR MICROSCOPE

(Continued from page 43)

grooves or removed without binding. Walnut is one of the best woods to use for the holder.

Procure two three-sixteenths inch brass rods about five inches long, a piece of heavy iron such as a two-inch pipe cap, a piece of three-fourths inch brass rod one inch long or a brass bar of similar dimensions, and two stove bolts with washers soldered into the slots of their heads to serve as handles or grips for turning.

MOUNT one of the rods in the center of the pipe cap, and insert the other into a hole bored into the end of the filter holder. Drill two holes through the short length of brass rod, at right angles to each other, drill two more holes into the ends of the rod, so that they intersect the first two. Tap the end holes for the stove bolts. Slip one rod into each of the untapped holes, and use the bolts for locking the brass block in position. You thus have an arrangement that is simple and at the same time adjustable as to height, distance of the filters from the base, and angles of the filters. Lacquer the wood parts and the iron base.

Just one more item and your filter equipment will be complete. You will, of course, need a source of artificial light that can be focused and projected through the filters to the reflecting mirror of your microscope or on the specimen directly. Many lamps are sold expressly for this purpose, but these are expensive and the simple homemade device shown in the photographs will answer your purpose.

To make such an illuminator, procure a metal-case, focusing-type flash light having a good reflector that will bring the lamp-filament image to a point. Remove the batteries, if any, and cut the center part out of the case, leaving the two threaded ends and an inch or so of intervening metal. This process eliminates the switch also. Solder the two threaded portions together so that you have, in effect, an extremely short flash light case. Obtain a 6 to 8-volt bell-ringing transformer designed for 110-volt house lighting circuits. Run a band of metal around the flash light case and bolt it to one end of a piece of hard wood. Through the other end of the wood in position drill a hole and slip it over one of the secondary binding posts of the transformer. The transformer thus becomes the base of the lamp.

Use a Mazda No. 40 lamp, the type intended for six-volt radio dial light installations, in the illuminator. This bulb, costing about ten cents, has a rated life of 1,000 hours on normal voltage. The transformer may produce a little more than six volts which will shorten the life of the lamp a little, but will make up for it by giving a more brilliant light. You can, of course, operate the lamp on a six-volt storage battery instead of a transformer. The lamp holder, that used to be a flash light case, can be tilted up or down, to direct the light through the filters into the microscope mirror or on the microscope stage when opaque objects are being viewed.

NOW that you have found how to make a ten-dollar microscope perform like one costing a small fortune, you are prepared to go visiting among some of the most expert workmen of the world and see, with the aid of your magic lenses, just how they carry on their delicate and deadly work. These workmen are the spiders whose webs you see every place, but whose beauty and wonders of craftsmanship you cannot appreciate without a microscope.

Before you draw *(Continued on page 93)*

COLORED LIGHTS AID YOUR MICROSCOPE

(Continued from page 92)

any rash conclusions about the desirability of spiders as material for study and entertainment, consider two things about them. First, the spider does not deserve the bad reputation that most persons are inclined to give it. Perhaps you think of a spider as something horrible, as a creature that will jump out and bite you with poisonous fangs at the first opportunity. The truth is that the spider doubtless is far more afraid of you than you are of it, and that only a few spiders possess a poison that is injurious to man. A spider merely seems horrible because you do not know him better.

SECOND, spiders have one big purpose in life—to capture and devour flies, along with other assorted insects. If you keep this in mind, you can understand much of the work that the spider does, as well as appreciate some of his anatomy. It is to capture flies that a spider erects a web that is a real engineering triumph. It is to kill flies that the spider ejects a poison through two fangs that the low powers of your microscope will reveal. It is to see flies that the spider has, on top of its head, a set of bright eyes. It is to enable the spider to bind a fly hopelessly in the twinkling of an eye, that it has a wonderful silk-making plant.

So it's the old story of the spider and the fly that you are going to investigate. But what a different story it becomes under your lenses!

Before you start peering at spiders, inspect a few webs. If you can find one of those silk creations of an orb-weaving spider, that hang in your garden, you have material for an interesting hour at your microscope. Touch, carefully, one of the silk strands that run out from the center of the web to a point of support. Nothing happens, except that the spider crouching at the center may become excited. Now touch one of the strands that run across the radiating threads. It sticks to your finger.

Push two common pins into a piece of cork or soft wood, about an inch apart, and carefully pack up some of the web threads, so that the silk is stretched between the upright pins. Try to get both the radiating and cross threads. Take this to your microscope, and focus it on one of the cross threads. At a hundred diameters, you will notice that the thread is not smooth as you had believed, but seems to be like a string of beads. Step up the magnification to 300 or more diameters, and you will see that the silken strand really is covered with tiny beads, often arranged with large and small ones alternating. On the heavier radiating threads of the web, you find no beads.

YOU have discovered one of the secrets of the spider web. The droplets or beads on the cross threads are composed of a sticky substance secreted by the spider. Their purpose is to hold any fly that happens to blunder against the web. The spider, then, is the real inventor of fly paper.

Now that you have had a glimpse of the uncanny workmanship of the web-building spider, you are ready to carry your investigations closer to that master spinner. But you need not, as yet, capture a live spider. Look carefully about the webs in your cellar or garden, and you will find, in some of them, what appear at first glance to be dead spiders. These are not dead spiders, but are the cast-off skins of perfectly live and active individuals.

These skins make excellent material for study because, in casting them off, the spider let go with them *(Continued on page 94)*

COLORED LIGHTS AID YOUR MICROSCOPE

(Continued from page 93)

many of the intimate details of its external make-up. The skins, for instance, show every detail of the feet with their interesting claws, the "chelicerae" with their poison-ejecting fangs or claws, the remains of the silk spinnerets, and even the hairs that cover the body and legs. The spider has, in shedding its skin, provided you with a better microscope specimen that you could prepare.

In handling the shed skin, you will have to exercise care because it is very light and fragile. A breath will blow it away, and careless handling with tweezers will crush the parts. If you want to preserve portions of the specimen, you can mount them in balsam, in built-up shellac cells. Be careful to eliminate all air bubbles from the hollow parts.

A SPIDER has six pairs of appendages or projections extending from its body. Beginning at the head and working backwards, you find first a pair of chelicerae, jawlike in appearance and in many species made up of two parts. There is a stout-looking, hair-covered base or mandible with a curved claw-like fang at its end. This claw can be folded down against the base like the blade of a knife.

When a fly blunders into the web or is otherwise caught, the spider sinks its fangs into the victim's body, perhaps also wrapping it in a silken straight jacket. Poison from glands situated inside the fore part of the spider's body is forced out through tiny ducts in the fangs, killing or stunning the fly. There are a few spiders whose poison is harmful to humans; but the chances are that if you avoid the Black Widow, you never will suffer a spider's bite that is poisonous enough to cause worry.

After the spider has poisoned its victim to insensibility or death, it proceeds to enjoy a feast. But it does not chew the fly and swallow it. Instead, it brings into use the second pair of appendages, called by scientists the "pedipalpi." Their bases serve as jaws for pressing the food to extract the juices, much as you crush a lemon in a squeezer. The juices are taken in through a mouth which is connected to the sucking stomach. After the feast the spider discards the crushed skeleton of the fly. You will find these remains in almost every web.

So far, you have disposed of two pairs of appendages. The four remaining pairs are the legs which, by their number, distinguish the spider family from that of the six-legged insects. The first pair of spider legs apparently serves much the same purpose as the antennae or feelers of insects.

Examine one of the legs under your microscope. You will find seven joints, with two or three claws at the end of the last segment. When there are three claws, two are arranged to form a pair, and the third is smaller and placed below the others. The large claws usually are equipped with teeth like a comb, and often the small one is toothed. Web-spinning spiders often have a number of serrated hairs which are modified hairs that help them cling to the web.

MANY species have on the tips of their legs, groups of hairs that enable them to cling to smooth surfaces, probably because of a sticky fluid that is secreted. In addition to all this equipment, the spider's leg usually is covered with simple hairs. Some nature students believe that the presence of so many hairs on the legs of web-spinning spiders prevents them from falling, the web strands catching beneath the projecting hairs if the spider's foot slips.

Your investiga- *(Continued on page 95)*

COLORED LIGHTS AID YOUR MICROSCOPE

(Continued from page 94)

tions of the silk-manufacturing part of a spider's anatomy will begin with the spinnerets found at the rear of the abdomen, on the underside. You can see vestiges of these on the skin that the spider sheds, but you can get a much clearer picture by using a recently killed specimen. Simply capture a web-spinning spider and drop it into a bottle of alcohol for a few minutes.

The spinnerets, usually six in number, are arranged in three pairs. In general they are covered with hair. They have hundreds of tiny tubes through which the silk-making fluid emerges from the silk gland.

Perhaps you wonder why there are so many silk tubes, and why an apparently single strand of web material really is the fusion of hundreds of tiny threads. The answer is: Speed! When a spider discovers a fly in its web, it rushes out and quickly wraps the victim in silken strands. The silk fluid, emerging through so many openings, hardens instantly upon exposure to air. Were there but one or at most a few openings, the comparatively large strands of silk would require more time to harden, and the spider could not spin its web rapidly enough to be of much help in building an insect trap or in binding its captives.

Now that you have been introduced to this master workman, don't you feel a little more kindly towards it? Spider webs may be a nuisance in your parlor, but those in fields and gardens and wherever else they do not interfere with your activities are a real benefit because they kill flies.

It is partly in this way that your microscope earns its keep. It makes you acquainted with the little creatures with which you are forced to live, and helps you distinguish your friends from those that would harm you.

ALL-WAVE PORTABLE MADE HOME SET

(Continued from page 59)

the lower half. The two-tube circuit was placed, panel and all, in the upper left-hand corner above the speaker. Since the cabinet had to be large enough to receive the extra parts and speaker, room also was found for two standard-size dry cells.

When studying the diagram, bear in mind that the counterpoise terminal is grounded to the two-tube chassis.

Since the enlarged portable was to be transported, a cover as well as a removable back was incorporated into the cabinet design. As shown, the under side of the top ledge of the cover serves as an excellent place to store the coils. Six sockets were mounted in a line to receive the coils.

REMARKABLE results were obtained by the builders in short tests. On one occasion, with the earphones plugged into the extra amplifier, GSC of England was heard. In another similar test a radio-phone to the Eiffel was logged, as were also local police signals and airports, the latter being heard on the speaker. With the exception of the English station, these signals were brought in on the six-foot antenna and six-foot counterpoise.

If, like many readers, you are so well satisfied with the original flyweight portable that you do not desire to alter it in any way, you can build the amplifier and speaker as a separate unit. As such, it can be wired directly to the portable set's earphone terminals. Then, when summer rolls around again, you need merely disconnect the amplifier unit and your ten-pound portable will be ready to serve as a valuable vacation companion.

Secrets of Success

STORIES THAT WILL HELP YOU GET AHEAD

The depression is over! Things are looking brighter. Factories are opening up. Men are going back to work. Farmers are buying as they plough their fields. People are buying. People are selling. The signs of returning prosperity are on every side.

What do these signs mean to you? Will you get a better job, be more secure on your present job, earn more money?

It depends! Depends on your *training*. Depends on whether you are equipped to take advantage of these better times. Depends on what your competitors have been doing to fit themselves for these better jobs. Here's one thing many of them are doing: They're devoting their spare time to study of International Correspondence Schools Courses! They're getting the training you must have to really take advantage of returning prosperity. They know we're in a new economic era—and knowledge is a greater asset than ever. It's wise for you to recognize this fact, too, and we will be pleased to send you the information that will help you get started in capitalizing on the return of prosperity. Just mark and mail the coupon. It can mean the beginning of real prosperity for you!

HIS "POSTAL-AD" SERVICE FILLS MERCHANT'S NEEDS

I WAS ONE OF those unfortunate engineers who graduated from college shortly after the Wall Street Crash, and have been more or less unemployed since. Engineering positions, especially for recent graduates who had little practical experience, were very hard to find. Diligently I set out for work in my own profession. After months of constant searching I could find nothing—in any line, no less in engineering. During my itineracy in search of employment, I came upon a display featuring an addressing machine.

This is a machine which does work similar to the mimeograph, except that it produces duplicates from a stencil on postcards, or postcard stock rather than on letter stationery. This machine is sold primarily to larger merchants who have a regular mailing list to whom they send advertisements printed on postcards.

This form of advertising appealed to me, and I realized that there must be smaller merchants who could not or did not wish to invest money in such a machine, but would like to utilize this form of advertisement if they could obtain it reasonably enough.

I FOUND that I could buy one of these machines on time payments, with only ten dollars for first payment. The only other necessary equipment was a typewriter, and I bought a second-hand one for fifteen dollars. Thus with only a twenty-five dollar investment I was ready for business. With some of the sample cards furnished by the company making the machine, I tried to interest the smaller merchants in this form of advertising, telling them that I could produce these cards with any type of picture they desired (tracing these pictures from newspapers and magazines) together with any copy. On blank postcard stock which cost me eighty-four cents a thousand I printed and sold to the merchants a thousand cards for three dollars and seventy-five cents which was considerably cheaper than a printer would charge for like amount. After deducting the cost of the blank card and cost of stencil which was eight cents, I had left a profit of two dollars and eighty-three cents a thousand.

By contacting the merchants in the morning and doing the printing in the afternoon I found I could easily do two orders of a *(Continued on page 97)*

Secrets of Success

HIS "POSTAL-AD" SERVICE FILLS MERCHANT'S NEEDS

(Continued from page 96)

thousand cards each, thus being able to make five dollars and sixty-six cents a day.

I called myself the "Postal-Ad Service," and printed some cards for myself which I left with the merchants whom I visited, so that if they did not care to have any cards made when I called, they could get in touch with me when they were running a sale or special. Thus I have beaten "Old Man Depression" and am able to get along in spite of hard times.—L. W., West Haven, Conn.

• • •

CAR RADIO VENTURE PROVES BIG SUCCESS

STARTING from scratch eighteen months ago, F. L. Schlink, of Portland, Oregon, has made a profit from the beginning by selling, installing, and servicing of car radios exclusively. At the present time, he is the only one so specializing in The Pacific Northwest.

Early in 1932 he rented a small garage for a service shop. It would accommodate only four cars. He had only one service man and did all the selling himself, helping with the service work in spare moments. Even now, while engaged in larger deals and more of them, if there comes a momentary interim between telephone calls or demonstrations to customers, he is into a car in an instant with pliers or test set, helping the men. It is this drive within him for utilizing every spare moment which, I believe, is in no small measure accountable for his success.

Soon the growth in business forced him to move into larger quarters, and he now has a space accommodating twelve cars, and it is occupied most of the time. Starting with an agency for one set, he now handles several of the best, nationally known lines.

"I dropped an assured position to start this business of my own," he said. "I was formerly sales manager in Minneapolis for a well-known automobile company. I selected this territory to start because it was practically a virgin one for car radios.

"In this business, I find that success must be built a step at a time, under close personal supervision. Selling sets is not all the battle. They must be properly installed and then serviced until all interference difficulties are ironed out to the complete satisfaction of the customer.

"While it would *(Continued on page 98)*

Secrets of Success

CAR RADIO VENTURE PROVES BIG SUCCESS

(Continued from page 97)

seem that I might stretch out rather rapidly, and appoint subagents in smaller cities. I find it difficult to get service men for this exacting work. So I am developing technicians here whom I can send out later to agencies.

When mine was a one man organization, I needed some business quickly. I selected the most prosperous industrial companies in the city, especially those having a number of well-paid executives who could afford car radios. When I got one of these men to install a set in his car, it was easy to get most of the others. The first place of this kind to which I went eventually developed into five additional sales for me.

After the individuals come the county sheriffs, who need short wave equipment to be in on the police calls that are going over the air. Similarly, the city police departments and the state highway police departments are ready markets.

Generally speaking, with the small organization and limited capital, first go after the cream which will fall with the least sales resistance. Develop the big, complicated jobs as you grow up.

As a man who applied himself to a new business and made a success of it during one of the hardest depression periods in our history, Mr. Sedlak's words are worth listening to and applying to a great many other ventures of this type.

—H. W. V., Portland, Ore.

Cash Prizes

THIS department will give $5.00 for every true success story submitted by readers of Popular Science Monthly, and which is accepted for printing in this magazine.

Manuscripts will be judged on the individual merits of the case and circumstances involved. Only stories in which the author's success, or that of some one known to the author, has been gained by some method of educational guidance, fitness for the job, or application to the work will be considered. We are not looking for the "get-rich-quick" type of story.

Manuscripts must be confined to 500 words or less. They must be true and, if accepted, authors must be prepared to give us signed statements to the effect that they are true. Manuscripts submitted and printed become the property of this magazine, and we are not responsible for the return of rejected stories unless postage is provided for this purpose. Address contributions to Success Story Department, Popular Science Monthly, 381 4th Avenue, New York City.

CAMERA AND LIGHT FIND NEW MYSTERY METALS

(Continued from page 15)

thirteen percent of chromium to the steel, he obtained a metal that was rust-proof and stainless, yet that looked like silver and was handsome enough to take its place among the table cutlery.

From this simple discovery have proceeded myriads of practical applications. Dentists pay three times as much for stainless steel instruments because they do not lose their temper through repeated heating in the sterilizer. Ordinary instruments have to be retempered every six months. A thin layer of the metal, used in the wall of a safe, makes the vault impervious to the acetylene torch before which steel runs like water. In radiator shields, wheelbarrows, and, even on the facings of the four 3,000,000-pound gates at Hoover Dam, it resists the action of the elements. The Chrysler Building in New York is trimmed from sidewalk to tower spire with stainless steel plates.

THE new metal has made possible today's high-octane, anti-knock gasoline which must be refined in cracking stills under temperatures of 1,200 degrees Fahrenheit and a pressure of 600 pounds per square inch. No other metal known will withstand such heat and pressure.

A strange recent discovery is that the alloy steel is stainless because it tarnishes rapidly. All metals tarnish, even gold, silver, and nickel. Iron forms rust, which is porous, admitting air and moisture to make more rust. But stainless steel's tarnish is instantaneous. It forms an impervious layer that keeps out air and moisture. Then and not until this layer of tarnish was ever found when metallurgists dissolved away the steel in acids, which left the tarnish floating on the surface as an almost intangible film, thinner than a soap-bubble.

You would hardly recognize some of the old metals in their new guises. Aluminum now appears in brilliant red, blue, green, black, and all the colors of the rainbow. A new process builds up an oxide on the metal's surface, which is then dyed any desired color. The finish will not come off. Aluminum beads and jewelry are being introduced with great success as a result of this process.

Many of the less common alloys, known chiefly to the scientist, may directly affect you though you may never know it. For example, there is hipernik—a new alloy of nickel and iron. Suppose this alloy were substituted in the 10,000,000 transformers that furnish light and power to the United States—a string of transformers long enough to reach from Baltimore to Los Angeles. Half the energy now wasted in transformer losses could be saved, a total of 15,000,000,000 horsepower yearly.

"WHAT are some of the uses for which you are seeking new alloys?" I asked a leading metallurgist.

"Far too many to count," he replied. "Superstrong metals to build skyscrapers and bridges. Superlight alloys for dirigibles, airplanes, and automobiles.

Let me give you one concrete example. Look beneath decks in a modern ocean liner. See the huge propellor shaft—a mass of metal three to four feet in diameter and 60 to 150 feet long. Imagine the saving in dead weight from a shaft of superstrong metal that need be only eighteen inches thick.

"See the huge boilers with shells two inches thick. Suppose a new metal were found that could stand the 1,000-pound steam pressure with only a one half inch wall. A modern liner weighs 40,000 to 60,000 tons. Superstrong alloys might cut this dead weight tremendously, producing new ocean greyhounds with the speed of racing boats."

MOUNTING A DEER HEAD

(Continued from page 76)

take short even strokes with the knife held as you do a pencil. When the ears are reached, cut the cartilage off close to the skull and proceed as far as possible onto the cheeks and throat, leaving the cartilage in the ear for the present.

Begin now at the apex of the Y-cut and skin forward over the head between the antlers. Be very careful to get all the skin off around the base of the antlers. Just above the eye there is a depression that is quite deep and has no flesh between the skin and bone, be very careful here as the skin must all be removed and no cuts made in it. Keep close to the bony orbit and insert one finger in the eye from the outside, to cut against, when cutting the thin membrane that surrounds the eyeball.

Cut the nostrils so far back from the end of the nose that the cut will not show on the finished head. The cartilage that divides the nostrils must be cut through edgewise down to the very end of the nose in order that the flesh there can be removed.

Cut the lips from the jaw close to the bone. These will later have to be cut open on the inside and all flesh removed. The skin of both lips and nose will have to be pared down later to prevent shrinkage, but just now the next job is to remove the cartilage of the ears.

Start at the base of the ear, *on the back*, and with the fingers and scalpel cut, push, and pull the skin and cartilage apart until the outer and top edges are reached. Gradually turn the ear inside out until all the skin is off the back of the ear. Start at the tip of the ear and work back on the inside, being very careful lest the skin be fractured, until the cartilage is entirely free of the skin. Do this to both ears and save the cartilage of at least one ear to be used in making lead dummies for the ears. The cartilage may be preserved by putting it in a saturated salt solution made by dissolving as much salt in hot water as possible and then letting it cool.

Clean all parts of the skin thoroughly. Be sure not a trace of the flesh or fat remains. Do not soak in fresh water or the hair will probably slip and spoil the skin. If there is some blood on the hair, wash it out before it has time to dry and then wipe the hair as dry as possible.

The last step in preparing the skin is to preserve it with fine salt. Be sure to rub plenty of salt into all parts of the skin (flesh side only), and when you think it has had enough, then give it three or four handfuls more! Hang it up to dry in a cool shady place, spreading it so that the air can reach all parts, but do not hang by the nose.

With the tape measure, take measurements of the neck at the base, at the middle, and where the neck joins the head. Put these records where they will not get lost.

Cut the ligaments at the base of the skull on one side and then on the other, and give the skull a good wrench to separate it from the neck. Find a tough stick that will fit into the hole at the base of the skull and pound the end of it until it is somewhat frayed. The brain can be removed by using this stick to dig it out with, while washing the skull frequently. Remove all flesh from both the upper and lower jaws, tongue, eyes, cheeks, and the like, and wash and scrape as clean as possible. Boiling will help this process somewhat and will not hurt the skull. In case you happen to have a cold chisel with you, the brain may be removed a bit easier if a hole 1½ in. wide and 3 in. long be cut in the base of the skull. This hole must be cut lengthwise of the skull and will later be used to receive the standard that holds the head.

Mounting. First cure the skin by putting it in a salt and alum bath and leaving it there until it becomes soft and pliable. A deer-head skin, as it is removed *from* the animal, is far too thick to mount well, so it must be pared down thin. The skin scraper and knife are the tools, and plenty of elbow grease is the medium that does the job. Scrape the whole skin as thin as you can get it without cutting the roots of the hair. The skin of the eyelids, lips, and nose must be pared especially thin.

The head, with the ears supported, is hung up to dry thoroughly before being pared

While the skin is in the bath, anoint the whole skull with arsenical soap and set aside to dry. Get out your measurements and make a neck board, somewhat egg shaped, with a circumference equal to the size of the neck base measurment. Use the ¾-in. board for this and bevel the top and bottom of the piece on opposite sides to conform with the slope of the neck.

When the skull is dry, cut the hole for the standard if it has not been done before. Place the skull on the table top with the forehead level and insert the standard. Mix up some plaster of Paris and, while holding the standard in a vertical position and the lower jaw in place, fill the brain cavity with the plaster. The lower jaw may be tied in position before pouring the plaster, but be sure to remove the cord before going any further with the work. Pile the plaster up in the base of the skull so that when it hardens the standard and the lower jaw will both be fixtures. Let it set until hard and then mark the standard to the proper length and angle. To do this, hold the standard up against a perpendicular object, such as a door frame, and after getting it the correct length and angle, have someone mark it for you. Cut it off on the line and attach the neck piece to it with screws.

Build up the neck by taking some excelsior, placing it around the standard, and winding it down with twine. The windpipe can be shown by sewing through the neck from side to side, starting at the lower jaw and continuing on down to the neck board. Test the size as you progress with the tape measure. Avoid getting it too (Continued on page 101)

MOUNTING A DEER HEAD

(Continued from page 100)

large, as the beginner is always likely to do.

When the neck is the correct size, mix up some potter's clay and tow, at least half a pailful, and give the whole head a coating about ½ in. thick. Work it out perfectly smooth with the hands. The clay should be thick enough to stand without sagging, but thin enough to adhere to the excelsior like glue.

Put enough clay on each side of the skull to form the cheeks and enough on the nose to replace the flesh and skin that were removed. Do not put any excelsior on the nose at all as it will usually show after the head is a few months old.

Make the ear cartilages next. Cut the sheet lead to the proper size and shape and thin it down toward the edges. Put a thin coating of clay on the lead and insert them in their proper places as soon as the skin has been properly poisoned. Take the skin out of the bath and anoint freely with arsenical soap, not forgetting the lips, nose, and ears. Allow the skin time to absorb the poison and then put the leads in place. Adjust the whole on the form carefully. Fit the eyelids and eyebrows in their proper places and put a tack or two through the skin of the forehead. Sew the skin tightly around each antler and down each side of the "V." Before sewing up the long part of the neck, put enough clay at the base of each ear and at the back of the skull to form these parts correctly.

Sew the long cut and then tack the edges to the neck board, trimming off what over-extra skin there is after it is tacked. Screw the head to a rough board so that it will stand while you are putting on the finishing touches.

Finishing. The real beauty of the head is in the finishing. Try to get the expression as it should be and not to make any part unnatural. First shape the cheeks, adding more clay if necessary or removing some as the case may be. Form the eyebrows next and shape the lids. A small brad will serve to hold the skin down into the depression over the eyes. Press the skin down on the muzzle and fill in the nose as needed. Fill the lips and close them together in a natural position. Be sure to give the nostrils a good depth—so deep that you can't see the end of them. Insert the glass eyes and work them into position. Three fourths of the expression is in the eyes, so be very careful and do not stop until it is exactly right.

Pin the ears in place till they are dry and then wash away all traces of clay or other dirt. Comb the hair until it lies naturally in place and then hang the whole head up to dry. If possible leave the head alone for a month, but in any event leave it as long as you can.

Paint the end of the nose, edges of the eyelids and the lips, if they have parted at all in drying, with Vandyke brown and black oil colors. Mix the colors with turpentine to remove the unnatural gloss. Lightly oil the antlers and fasten the whole to a rich-looking shield. The shield is not necessary, but if not used the neck board must have some sort of hook attached to it by which the head may be hung on the wall.

Formulas. Salt and alum bath: water, 1 gal., alum, ¾ lb. (1 pt.); salt, 1¼ lb. (1 qt.). Heat to boiling point, stir occasionally, and keep in wooden, earthen, or glass container.

Arsenical soap (Hornaday): white bar soap, 1 lb., powdered arsenic, 1 lb., camphor, 2½ oz.; crude potassium carbonate (pearlash), 3 oz.; alcohol, 4 oz. Slice and melt soap in a little water over a slow fire. Then add potash and stir in arsenic. Dissolve camphor in alcohol and add to mixture. Stir and boil down till the consistency of thick molasses. Pour into wooden or earthen jar to cool. While cooling stir once in a while to prevent arsenic settling. To use, mix small quantity with enough water to make it the consistency of buttermilk and apply with a paintbrush.

If you like POPULAR SCIENCE MONTHLY why not pass the word along to your friends. When an article in this magazine strikes you as being unusually good, tell your friends to get a copy at the newsstand, and read it.

MODELS TO SAVE AMERICA'S COASTLINE

(Continued from page 59)

the public does not visualize the danger from these sources. Yet in one form or another, the seas, the streams, and bays in many places constantly threaten to destroy property and, sometimes, lives.

At Vicksburg, Miss., where the Erosion Board maintains elaborate model studies, at Ft. Humphries, at the University of Iowa at Worcester Polytechnic Institute and at the California Institute of Technology, the engineers are moving forward along a broad front in their attack on these problems.

OF immediate interest, the toy rivers, shallow ocean, narrow channel, tiny bay, small beaches, and miniature jetties at the California institution bring together for the first time all the conditions that perplex the scientists. Here Professor R. T. Knapp, who, with the advice of Col. Charles T. Leeds famous consulting engineer, constructed the model, is building in miniature a new and straight channel to replace the meandering San Gabriel river, preparatory to emptying it directly into the Alamitos Bay channel and thence straight out into the Pacific. Similar problems at the mouth of the Los Angeles River and Ballona Creek, both in southern California, will be attacked once success has been achieved with the complex studies here.

There has been much work with hydraulic structures in the past, but they have dealt primarily with the erosive effects of rivers. In Europe, particularly in Germany, scientists have devoted some effort toward solving bay and ocean problems, though little has been done with a combination of river, bay, ocean, and beaches.

Engineers are turning to models for these studies because the problems are so complex and the variables so many they can find no practical answers through mathematical calculations alone. Though the studies rapidly are extending over the United States, each problem is peculiar in itself. By means of these model studies, general types of designs and means to hold rivers in check, prevent bays from filling with debris during flood, and build up shore lines at points where rivers empty into the seas will be developed.

Recently an impetus was given to the study of the problems by the plans of the Los Angeles County Flood Control District to change the course of the San Gabriel river, a meandered stream that overflows occasionally in the upper end of Alamitos bay and deposits vast amounts of debris. Engineers of the Los Angeles Gas and Electric Co. studying these plans, decided that trouble might arise at the mouth, where the current passes a large intake through which that Company's plant, on the shore of Alamitos Bay, sucks in sometimes 7,500 gallons of water a second for cooling its machinery.

WHEN the new river now under construction, comes in, the engineers asked, will it so change the under-water topography as to interfere with the large inlet, permitting sand to flood into the complex machinery? Not only would this mean expensive litigation, but it might cause the beach on both sides of the channel to wear away. Here private and public interests join hands.

In order to make a detailed study of the problem, Professor Knapp built the model. It consists of a flat, water-tight floor which is the support. River banks and shore lines are made of weak concrete which may be quickly destroyed to make way for another model. Soil and sand form the floor of the ocean, bay, and rivers.

The entire model is built to the scale of one inch in width for ten feet. One inch in depth corresponds to five feet. How, then, did Professor Knapp test it to make sure results would compare with actual conditions?

Models, to be wholly successful, must simulate movements as in nature. Scientists first construct a model, then operate it over a sufficient period to determine whether it behaves as its prototype is known to behave. That is, the artificial tides must move sand on the bottom in proportion to the movement produced by ocean tides. If the model erodes as in nature, it is reasonable to conclude that changes in the conditions—a new stream bed, for instance—will react as would a similar change in nature.

KNAPP, therefore, first studied the fineness of the material in Alamitos Bay. Later, by measuring the surface velocity of a shallow stream of water flowing down an inclined channel, built of metal and observing the effects on the sandy bottom, he chose the sand most suitable for use in the model. Particularly, he determined at what velocities the bed began to move for different depths of water covering it. Some sand, he observed, moved in bulk; other sand produced a ripply, wash-board effect.

Then he was ready to cause his rivers to run, to produce his ocean currents. One day he sent a stream flowing down the present San Gabriel river, next day he caused the new channel to be filled with water, on the third, he had tides ebb and flow. After each process the model was emptied, and Knapp took vertical photographs of the erosive results that they might be compared with measured erosion on the actual site.

Tides sometimes build bars inside bays. So Knapp built a bar inside the tiny harbor exactly one one-hundred-and-twentieth as broad and one sixtieth as tall as a similar bar in Alamitos Bay. Then he caused the tides to be produced, twenty times as fast as the tides in nature move. By introducing water from a sunken pipe on the ocean side slightly faster than it was permitted to escape at the head of the bay, the tide built up and acted precisely as a real tide behaves. When the inflowing tide reached its peak, the valves were reversed and it ebbed seaward at the same rate.

But how does he translate his observations back to nature? Merely by multiplying the results according to the arbitrary scale adopted. If the tide erodes a channel a half inch deep, a similar tide at Alamitos Bay under the same conditions would produce a channel thirty inches deep.

From an elevated tank, water flows under constant pressure into the model, while delicate instruments measure the ocean's flow into the bay and tell him at all times the exact stage the tide has reached. By these means the conditions may be controlled to a remarkably precise degree and observations noted which cannot be made under conditions of nature.

BUT there are other secrets the seas must be made to reveal. When and how and why is sand packed up and transported to another location? What is happening on the bottom of the sea? Is there any way to induce the oceans to bring in material from their depths to re-create old coast lines? How long does it require the ocean to wash a grain of sand half a mile? How does the sand behave on the bottom of the sea? How quickly does it shift from one position on a beach to another?

The Beach Erosion Board and the Shore Protection Board seek answers to these queries. Specific (Continued on page 103)

USE MODELS TO SAVE VANISHING COASTLINE

(Continued from page 102)

problems have been presented to them by various states and, with the cooperation of university scientists, they have proceeded with definite experiments.

From Long Branch, N. J., these boards have conducted their principal field operations. There they find a wide variety of natural and artificial conditions that aid in the investigations. The adjacent coast consists of a more or less continuous barrier of beach, separated from the mainland by a series of lagoons, marshes, and thoroughfares.

NOW picture the investigators at work. Four wagonloads of red sand slide into a trench extending down to the sea. Again six loads are similarly deposited. What did the sea do about the imposter? Moved it at one point parallel to the beach. Discolored water told the tale. The rest remained in the trench until changing weather eroded the beach. Meantime the red sand had become covered under lighter, local sand as deep as two feet. During erosion, the red sand was found as far distant as 500 feet.

Other observations at Pensacola, Fla., revealed that two-foot waves in water seven feet deep disturbed sand lying on the bottom. Odd-h, some waves would raise the sand in a cloud while others moved it only slightly.

Again, sixty croquet balls were weighted with lead so as to simulate tiny particles of sand and settle through the salt water at about the speed which settling sand would achieve. Thirty of these were placed in the ocean 2,000 feet off shore. Others were dropped during rough weather along the Long Branch pier. Only one in sixty was washed ashore—and this had lost its weight and risen to the surface. Here the experiment indicated that forces along the bottom of the Atlantic either were not strong enough to bring the balls ashore.

Two meters, set at right angles, were lowered into the Atlantic. These delicate devices designed by Dr. Ch. B. Pertam of Columbia University, would reverse almost instantaneously, thus making it possible to record oscillatory movements due to the passage of waves and the drift parallel to the shore. An electric recorder made it possible to show the direction as well as the speed.

Other observations were made to show the continuous path of a particle of water 400 feet from shore at Long Branch. A vertical staff like float was used, the lower end being equipped with large vanes to cause it to move with the water particles.

HOW fast was the sea advancing to the attack and receding after having struck its blow? From a total of 1,100 observations, the Atlantic rushed toward the shore at an average speed of 1.33 feet a second and retreated 1.29 feet every second.

Meantime the sand shifted along the bottom, possibly to build up the shore or be carried further seaward. A diver descended into the Atlantic to study these movements. At various ratios sea speed from 700 feet to a mile offshore, he walked along the bottom. He reported that the movement grew less as the distance from shore and depth of the water increased.

All these experiments, though seemingly unrelated, bear definite connections. The engineers know that our shore lines are breaking down and being carried away, either directly to deep water in the oceans or coastwise to new locations. To stop these depredations, that over a period of centuries would prove so costly, they observe the effects of the structures built to save the shore and then turn to models in the laboratories to find designs that will prove effective.

YOU CAN PHOTOGRAPH MOON AND STARS

(Continued from page 37)

which you have found and marked by looking at the weathervane, since the blue rays of light which affect a photographic film are brought to a focus nearer to a simple spectacle lens than the yellow rays which form the image the eye sees.

To find the photographic focus, place a film pack in the camera, and see that the camera tube is slid in until the pencil mark you made on it is at the end of the telescope tube.

PLACE a loosely fitting cardboard cap over the object-glass end of the telescope. A large pill box cover will do. It must fit closely so that it can be removed without jarring the instrument. Then remove the safety cover of the film pack, and draw out the camera's dark slide as far as it will go. You are now ready to make several experimental exposures to determine the photographic focus.

To do this, train the telescope on some bright star near the sky's equator, using the finder tube. In order to see the threads clearly, have a friend illuminate them from the side with a flash-light lamp—or hang a lantern so that it lights up the threads. When the star is on the cross threads, go quickly to the object glass and remove the exposure cap, being careful not to jar the instrument. Count thirty and replace the cap.

Now, as quickly as possible, slide the camera tube into the telescope tube about a quarter of an inch, mark the place with a pencil stroke, go to the object glass, remove its cap, count thirty and replace it again. Repeat the process once more, and then take out and develop the film, as already described.

You will find on the film nothing but three short, dashlike trails in a line. They were made by the bright star you sighted at, during the three half-minute exposures.

These dashes will vary in sharpness. If the center one is the sharpest, you will know that the telescope tube should be permanently fixed so that the second pencil mark on the camera tube is at the end of the telescope tube. If either of the other trails is the sharpest, place the camera tube in permanent adjustment at the corresponding pencil mark.

Now at last you are ready to take your moon picture with your telescope correctly focused. The procedure is exactly the same as above, except that when you make the exposure you must remove the cap and replace it as quickly as possible. Do not leave the object glass uncovered more than half a second.

A second lasts while you say, "thousand and one." A half second is represented by about the time it takes to say "thousand." This is a good guide for exposure when using an ordinary film pack. Superspeed film would require less exposure.

In taking moon pictures with a telescope, two enthusiasts can work together with advantage. One watches through the finder tube until the moon is exactly on the cross threads. Then he gives the word, and the other makes the exposure while the moon's image is exactly in the center of the film.

WHEN working alone, you must work quickly or you may find, on developing, that the earth's motion has carried the moon's image partly or entirely off the film. A good plan is to put the ground glass in the camera, point at the moon, and watch the moon's image travel off the field of view, meanwhile timing its disappearance with a watch. You will thus find out just how many seconds you have to make the picture.

The method used in taking star pictures is slightly different from that employed in moon photography, for the exposure must be longer, and some way must be found of making the stars sit still for their pictures. They must be prevented from making trails across the film, as they did in the polar-trail picture that appeared in the first article of this series.

The answer is to remove the telescope from its mounting, and replace it with an ordinary camera. Make another finder tube and fasten it below the camera, as shown in the illustration, entering both as already described by using a distant weathervane.

In fastening the camera firmly you will find you need a quarter-inch bolt with twenty threads to the inch. The threads on this bolt exactly fit the threads in the tripod socket.

Any double-lens camera can be used, but the greater the speed of its lens, the better the resulting maps will be. An *F/4.5* lens is ideal, but even one whose largest diaphragm is F/8 can be used. Single-lens box cameras are of little or no use.

In order to prevent the formation of trails by the stars being mapped, the camera and its attached finder tube must be made to follow their movement as exactly as possible.

This slow, steady movement can be secured with a little practice, and the aid of the slow-motion device illustrated. This slow-motion mechanism is merely a lever pivoted upon the equatorial mounting. Its sharpened upper end fits into a V-shaped notch cut into a disk which can be adjusted by a set screw upon the polar axis of the equatorial.

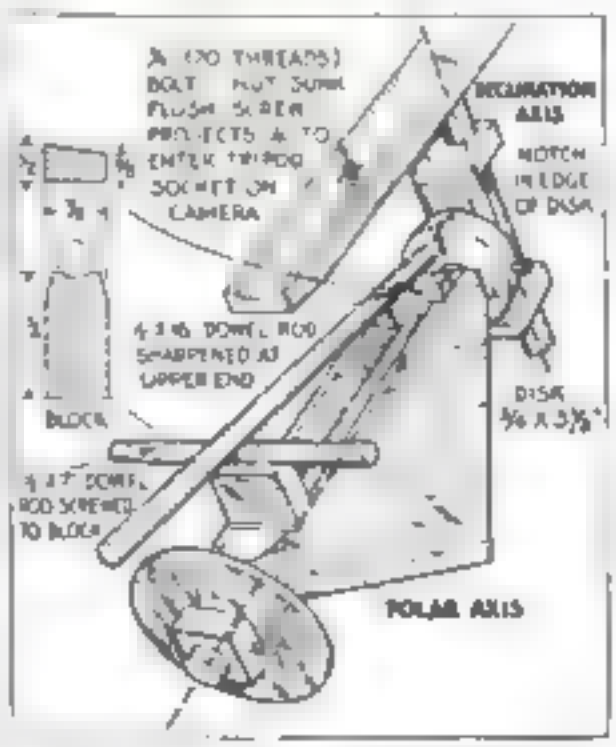


Diagram shows how to construct the camera for use with a telescope in taking moon photos

THE observer, watching some bright star through the finder-tube applies a slow steady pressure upon the lever. This keeps the star upon the cross threads in front of the finder-tube. The camera accordingly follows the movement of the entire constellation, and the resulting picture will be made up of dots.

With a fairly fast lens on your camera, you will be able to get good star maps with exposures of five or ten minutes. To hold the star on the cross threads of the telescope for longer periods becomes very tiresome.

In conclusion, let me add a word of caution. Be sure to take pains that the polar axis of your equatorial lies exactly north and south and that its base is level. Otherwise the telescope will not follow the stars truly.

In the next article an experiment will be given that will enable you to find the true north, either for the purpose of setting up an equatorial or for setting a sun dial accurately. Other experiments will explain the seasons, the equinoxes, the solstices, the midnight sun, and the differences between solar time and standard time.

STRANGE INVENTIONS USED BY GAMBLERS

Continued from page [illegible]

produced by the cutting knife at the factory varying up or down a fraction of an inch when it sliced across the design. In the end, he found enough differences to make a deck in which he could recognize any card. Throwing the rest away, he packed these pasteboards in a glassine wrapper and box and had a deck which could be examined under a microscope without finding it altered in any way.

By cutting tiny strips off the tops of certain cards in the deck, the crooked player sometimes alters the upper-edge design of these cards so he can recognize them. Again, he may trim the corners so he can feel them in dealing. A variation of this trick is the production of humps and strippers. Humps are cards trimmed so they bulge slightly at the top and bottom; strippers so they bulge at the sides. Although these alterations are so small they cannot be seen, the practiced fingers of the sharper can feel the cards he wants and can cut or manipulate the deck so he will get the high-value cards.

Marking this card with invisible ink, the crook then wore special glasses to see the marks

"Slick ace decks" help the card cheater in much the same way. They are manufactured with the ace, or any other desired card, polished until it has less friction than the other cards, thus causing the deck to cut most easily at the place where the wanted card is located.

The oldest method of marking cards during play is "crimping the deck." By bending the corners of cards slightly up or down, denting the backs with his fingernail, or bending the pasteboards in the middle, the crook marks important cards as the play proceeds. Sometimes a special ring or thumb-prick is worn having a small raised point which can be pressed into the backs of cards, the position of the mark distinguishing them.

SOME years ago, a notorious master cheat in the east produced a "[illegible] eye shade" which enabled him to trim suckers for several months before its secret was discovered. The shade was made in a special color while the backs of the cards were marked in invisible ink which could be seen only when looked at through a transparent substance tinted the hue of the eye shade. The other players looked at the cards and saw nothing. He looked at them and saw in glowing letters and numbers the marks that identified them all. Today, such shades, as well as tinted glasses, for the same purpose are on the market.

"Chink Ink" and "Golden Glow Daub" are also available for marking cards by cheaters. The former is a special preparation that is placed under the fingernail and so transferred to the upper edge of a card, the position indicating its value. The daub comes in a tiny pot which can be sewed into the hem of a vest with a small slit opening outward. By rubbing his fingers over this slit, the crooked card player smears them with the fluid which leaves a delicate smoky smudge on a card and (Continued on page [illegible])

STRANGE INVENTIONS USED BY GAMBLERS

(Continued from page 105)

nable him to mark the deck while playing [illegible] deftly with colored [illegible] that rubs off on the fingers are sometimes employed.

In an eastern city, a few months ago, an ingenious vest button enabled a card shark to clean up several thousand dollars at stud poker before he was caught. The six buttons running down the front of his vest appeared to be all the same. But the one just below the level of the table was equipped with a sliding top and a tiny mirror. [illegible] he could, by bending forward at an angle which [illegible] direct reflection into the mirror and enabled him to know what his opponents held and to bet accordingly.

This scheme is a new variation of the old [illegible] trick in which little [illegible] are secreted in match boxes, in piles of bills, or in the chewed end of a cigar, to show the crooked card dealer what his opponent gets. Highly-polished signet rings are sometimes employed as shiners without attracting attention. Recently, convex mirrors which show the whole face of the card and which do not throw reflected light that would give away the fraud, are being adopted.

While this is [illegible] police in a [illegible] have reported the discovery of the latest in such devices, a "holdout gun." It is a convex mirror attached to a lazy-tongs arm which shoots out from under the player's vest when he pulls a wire by spreading his legs apart. The mirror is projected only when it is needed and is safely hidden out of sight during the rest of the game.

Such holdout mechanisms, strapped to the wrists with elastic bandages or hidden in the linings of coats and vests, are frequently used to switch cards or to supply kings and aces when they are needed by the crook gambler. The users are known as "machine men." The [illegible] are that they sometimes have to make unnatural or machine-like movements in operating their holdouts usually gives them away sooner or later.

In one instance I heard of, a holdout worked too well. It was designed to operate without any tell-tale movement of the hands or legs, a wire about the chest projecting the lazy-tongs arm when the gambler took an especially deep breath. It worked without a slip for more than a week. Then, in the middle of a game the wearer had to sneeze. The sudden intake of breath operated the device and out popped an ace in full view of the other players!

Called "the coat spider," a small spring blade, with sharp prongs attached, is designed to hook on the underside of a coat sleeve, holding from one to six cards tightly against the cloth.

MANY of the latest holdouts are installed [illegible] the factories where they are made. The gamblers sending in their coats or [illegible] the purpose. One device is advertised as being attached inside the lining in such a way that the coat can be taken off, turned wrong-side-out and shaken without danger of [illegible]. Other silent, speedy working mechanisms of the kind are so perfectly constructed that they can be used even when the sharper takes off his coat and plays in his shirt sleeves.

The devices I have described are by no means all of those used in the realm of crooked gambling. New ones appear constantly. Nor are they the sporadic products of a few individual crooks. They are factory-made and widely distributed.

Anyone who gambles today, not only bucks the laws of chance but is likely as well to meet the chicanery of science-using crooks.

CIVILIZED MEN 15,000 YEARS AGO

(Continued from page 23)

stick and flint scraper knife were similarly embedded along with two fireplaces in which wood and sloth remains had been burned. Apparently the fires had been extinguished soon before the sloth abandoned the cave. These constitute his evidence.

But what of the sloth man? His features cannot yet be reconstructed for his remains have not been found. But his weapons and his tools are revealed, particularly his atlatl and dart. The atlatl is also known as a throwing stick. It consists of a stick about twenty inches long with a handle at one end and a [illegible] hooklet at the other. The spur engaged a [illegible] cup drilled in the butt of the dart.

In use, the atlatl and dart were held in the right hand, with the butt of the dart against the spur. Then the dart, cast with a sweeping overhand motion, flew through the air with great force. The object of the primitive device was to lengthen the sloth man's arm by the length of the atlatl and consequently to give him greater force in casting the dart.

THE darts, usually, were four to five feet long, feathered like an arrow, and were provided, around Gypsum Cave, with a stone point. Even today the atlatl is found among the aborigines of Australia, in Melanesia and Micronesia and in Siberia, while the Eskimos bring down much food with this weapon.

The Gypsum Cave discoveries, associated with others in various sections of the United States, enable Harrington to catalog the extinct animals with which these ancient peoples associated, including that strange Proboscidian-like beast whose pictograph was found by Charles Kelly not long ago on a cliff near Moab, Utah. This was a curious snouted creature, not unlike the hippopotamus. But he was not the sole associate. We now have evidence that the early American lived among [illegible] ground sloths, the Lesser camel, horse, muskox, four-horned antelope, giant vulture, short-faced bear, and direwolf.

Meantime North America was being peopled by a sturdy and intelligent race, whom Harrington terms "Late Solutrean," the ground sloth people. Very low types of man, Harrington tells me, such as the Neanderthal, probably never reached the Americas. Instead a modern type began to filter in from Asia about 20,000 years ago. It was their descendants whose fires he found in Gypsum Cave.

"Migrations continued in ever growing volume," he said, "and the Solutrean type of flint working supplanted the earlier style except in isolated places, such as Cuba. The time was about 14,000 B. C. Many animals now extinct were still abundant.

Man in a higher state of development reached our shores during the same period, probably by way of Asia and perhaps through Iceland and Greenland, but these hands kept to the north, following the retreating glaciers, and became the ancestors of today's Eskimo.

"In the south, the ancestors of the American Indian were spreading rapidly, cultures were changing and local patterns developing. Arid conditions were establishing themselves in the southwest, particularly in the Great Basin. Pleistocene animals were becoming extinct. Here ground sloth, horse, and especially the camels were the last to go. Farther north and east, the mastodon still ranged, now invading formerly glaciated country. This was the date of Gypsum Cave!"

(Continued on page 107)

AMERICA HAD CIVILIZED MEN 15,000 YEARS AGO

(Continued from page 106)

"But what followed?" I asked.

"What I have told you represents theory," Harrington replied. "From here on we have fully established fact.

"A long period of slow development ensued. Its early stages corresponded in time with the European Neolithic. Immigration slackened, but did not cease before certain Neolithic ideas, such as the bow and arrow and the celt, or grooveless axe, had reached America. Old World food plants, however, were not brought over. American agriculture is of independent origin. American working of copper, gold, silver, and bronze is likely independent also.

"Great cultures developing agriculture, pottery making, loom weaving, and metal working sprang up in the south and streams of influence spread among the more primitive peoples; but the greater part of North America was still Neolithic in culture when first explored by Europeans, although the working of copper in the Mississippi Valley and the Great Lakes region, with the addition of gold and silver in what is now Mexico, was well under way.

"The Iron Age missed America altogether, and only in Peru do we find anything equivalent to the Bronze Age of the old world. This entire period covered approximately the years from 10,000 B. C. to 1,500 A. D. and belonged to the Recent geologically, although the elephantlike mastodon seems to have survived in the northeast for a long time. In certain regions, such as the southwest, archaeologists have been able to divide the final 3,000 years into culture stages, terminating in the coming of the whites and the consequent sudden destruction or gradual breaking down of the native American culture."

PLANT GROWTH STOPPED BY HEAVY NEW WATER

SMALL quantities of a new kind of water, answering to the familiar formula "H_2O" but heavier than ordinary water and possessing mysterious powers of inhibiting the growth of live things, have been prepared by Dr. Gilbert N. Lewis, of the University of California. Tobacco seeds, placed in the new water, failed to sprout although they sprouted in ordinary water in two days. As yet the effect of the water on human beings is unknown, but tests that Dr. Lewis plans on small animals may lead to striking discoveries. The mystery of the heavy water's powers comes as a sequel to the discovery, a few months ago, that water contains two kinds of hydrogen atoms, light and heavy ones. This in itself was a startling fact to chemists, who had always supposed all hydrogen atoms of equal weight. It remained for Dr. Lewis to succeed in preparing water containing a predominance of the heavy kind of hydrogen, by separating it electrically from the lighter kind, with the result that a new substance of unknown and perhaps important new properties has been found.

OLD AGE POSTPONED BY REMARKABLE DIET

RECENT discoveries in nutrition promise the new generation a life span ten percent longer that their heredity would otherwise have entitled them to, declares Prof. H. C. Sherman of Columbia University. Moreover, a properly planned diet will postpone the effects of old age so that a man of sixty-five or more will retain his full faculties and vigor, and the result, Prof. Sherman foresees, will be a new society guided by its older heads. The new diet is planned to supply certain organic acids that have been found to play a vital role in health.

New Triumphs of Transatlantic Electric Ships

(Continued from page 17)

To see at first hand some of the wonders of this latest trend in merchant shipbuilding, the writer recently made a tour of inspection of the turbo-electric *Queen of Bermuda*, the most modern and luxurious electric liner in present service.

Under the guidance of engineers and electricians, I saw propellers being put through their motions, gyro-compasses spinning, water-tight doors clanging shut in response to distant signals, cargo being hoisted, food steaming in giant ovens, the great rudder responding to invisible impulses from the bridge. The maze of steam piping of the steamship of a few years ago was conspicuously absent. Wherever there was light or heat, or work being done, or delicate devices operating for the ship's safety, electricity, conducted through copper wires, was in command and doing all the work.

IT happened that my visit was on the morning of sailing, when deck officers and engineers were preparing to give the motors a turn-over, to make certain that the propelling machinery was in perfect order.

Before an immaculately groomed main switchboard, deep in the engine room, the chief electrician and the staff chief engineer, with several white-overalled assistants, stood waiting at attention. Suddenly, over the soft purring of idling turbines, came the clanging of the bridge telegraph: port outboard propeller—slow—ahead!

Immediately an assistant had answered the signal, an electrician was slowing turning one of the two large nickled wheels which, through an intricate automatic relay system, control the entire operation of the turbines and propelling motors. In a matter of several seconds, turbines had been speeded, the port outboard motor slowly turned over, and a signal returned to the bridge that the operation had been completed.

In rapid succession, the telegraph clanged orders for each of the four propellers. Smoothly and rapidly, the orders were carried out. By a slight throw of a smaller wheel, the propellers could be put into reverse. So simple was the manipulation of the machinery of this electric ship, that complete control of her 19,000 horsepower could, in an emergency, be accomplished by a single man operating the controls.

I was soon to find out, however, that the marvellous electrical service of the ship did not end with the driving equipment. Electricity was functioning everywhere.

In the engine rooms, electric oil pumps, ballast pumps, bilge pumps, water pumps, stand ready for instant duty. Water-tight doors in the bulkheads are opened and shut by electricity. Huge electric blowers keep these rooms constantly at a comfortable temperature. Hydro-electric steering gear smoothly maneuver the rudder. While all the ship's refuse is digested and expelled under the water by an electric sewerage system that insures sanitary conditions.

TIME throughout the ship is told by electricity, food is cooked, cabins heated and cooled, perishables refrigerated, clothing and linens laundered. Electric cranes, capstans, and winches haul lines and anchors and lift luggage. Lifeboats are raised on electrically-operated davits. An automatic fire alarm system flashes instant warning of excess heat in any part of the ship, and electric fire-fighting equipment is immediately available to quell a possible blaze.

Besides the usual radio telegraph and telephone apparatus and radio compass, the electrical equipment of this new ship is finally completed with a gyroscopic compass, electric bridge telegraph, electric fathometer, electric log, and the very latest electric eye of Macneil which is capable of detecting objects through miles of fog.

Strangely enough, the electric ship, which is now being brought to such a high state of perfection by European shipbuilders, was pioneered by American engineers and first proved practical by the United States Navy and Coast Guard. Nikola Tesla, inventor of the motors which make electric drive possible, was one of its first strong advocates. William LeRoy Emmet and Eskil Berg, engineers of the General Electric Company, went far to make the electric ship a reality.

THE first argument of these men was speed reduction between turbine and propeller. For highest efficiency, turbines had to be designed for speeds ranging from about 1,000 to 3,000 revolutions per minute. Propellers, on the other hand, wasted power extravagantly when whirling at more than, say, 300 revolutions. By coupling the ship's turbines to electric generators, and then conducting this power through copper wires to motors connected to the propeller shafts, any speed ratio desired could be easily attained, and both propellers and turbines could be operated at maximum efficiency.

But this was not the only talking point of the pioneers. Mechanical gearing had already been developed which could perform this service with less weight and at less initial cost. Electric drive, they insisted, possessed a number of other advantages which could not be matched by any other type of ship-propelling equipment in existence. One was rapid reversing of the propellers, at the mere throw of a switch. With ordinary turbine drive, reversing was a complicated feat requiring a transfer of steam from the ahead turbines to special astern turbines.

Another advantage was the possibility of cruising at slow speeds, when desirable, with merely a half or a quarter of the turbo-generating plant in operation, reserving the entire plant for extreme bursts of speed. A factor of economy in ordinary runs, this advantage might prove vital in case of a turbine breakdown at sea. Instead of dragging a dead propeller through the water, the disabled turbine could be completely shut down and all the propeller motors operated from the remaining turbines.

Despite the theoretical advantages, this type of propulsion was persistently turned down by both merchant and naval shipbuilders until 1913, in which year the U. S. naval collier *Jupiter* was equipped with a 6,600-horsepower plant as an experiment. The *Jupiter* proved so economical and trouble-free in her trials that five years later electric drive was chosen for the great dreadnaught *New Mexico*, and subsequently for every first line battleship of the United States that has been constructed since.

BY 1927, with the commissioning of the giant aircraft carriers *Saratoga* and *Lexington*, the United States Navy could boast electrically-driven ships faster and more powerful than any other large ships in the world.

Adding to the remarkable experience of the Navy that electric ships were unusually rugged, easily handled, and could be built to stupendous powers, the Coast Guard introduced an innovation which was to revolutionize the whole trend in design.

Although Captain Q. B. Newman, then chief of engineering, was certain that for the strenuous and hazardous duties of Coast Guard cutters, electric drive was superior to all others, he was confident that properly designed synchronous motors could spin the propellers more efficiently than the induction motors used by the Navy. Synchronous motors were lighter and cheaper for a given horsepower. His decision to have synchronous drive installed in the little cutters *Tampa*, *Haida*, *Mojave*, and *Modoc*, which were put into service in 1921, set an example which has been followed by the present fleet of electric merchant ships.

The first important vessel of this fleet was the palatial, 20,000-ton *California*, of the Panama Pacific line, put into service in January, 1928. By the beginning of the next year, two sister ships, the *Virginia* and the *Pennsylvania*, were operating on the same run and also electrically powered.

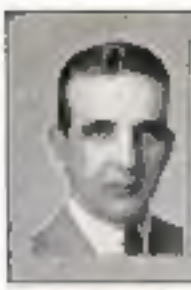
Inspired by the success of these ships, Great Britain built the *Viceroy of India*, which introduced electric service to the long run between England, India, and Australia. In the succeeding five years came the *Monte Castle* and the *Orient*, the *President Coolidge* and *President Hoover*, the *Strathnaver* and *Strathaird*, and finally the new *Monarch of Bermuda* and *Queen of Bermuda*. At the present writing, the electric ship total has climbed to more than 1,200,000 horsepower.

The electrification of the *Normandie* comes as a climax to a meteoric development. Electric drive was chosen for most of the present ships because of some peculiarity of their runs, such as the necessity for long periods of slow speed cruising, or tortuous channels through which extreme maneuvering qualities are essential. The fact that the largest ship in the world has chosen this means of propulsion merely for achieving greater speed, comfort, and reliability across the Atlantic may signify the beginning of a major revolution in shipbuilding.

• • •

First Telephone Used to Help Escaping Slaves

America's oldest telephone, pictured here, was used before the Civil War by abolitionists who helped negroes escape. It consisted of a wire attached between drumlike boxes containing diaphragms. A ringing bell announced that a message was to be sent.



Never Seen Equal

"Logged several Central American and Mexican stations, short and long wave, last PM. Pipton. Never seen anything to equal this new Midwest-16 for tone fidelity and sensitivity everywhere."—F. N. Stewart, Vero Beach, Florida.

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Camel's Costlier Tobaccos

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